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Stock Assessment of the Return of Early Run Chinook Salmon to the Kenai River, 1991

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ABSTRACT

The total inriver return of early-run chinook salmon *Oncorhynchus tshawytscha* as estimated through hydroacoustic techniques was 10,931 fish.

The estimated angler-effort and harvest as measured from creel survey during the early (May and June) chinook salmon run were 47,599 angler-hours and 891 chinook salmon, respectively; the second-lowest value on record. Release mortality was estimated at 116 fish. Spawning escapement (9,924) was estimated through subtraction of total fishing mortality from total inriver return and met spawning requirements stipulated in the management plan. The predominant age class of both the inriver return and recreational harvest was age-1.4 fish.

Migratory timing models were used to project spawning escapement during the 1991 fishery. Severe restrictions of the fishery were required to achieve escapement goals.

Production from the 1985 and 1986 brood years is likely to be little better than replacement. A sibling model was used to forecast the 1992 return at 12,917 fish.

KEY WORDS: Kenai River, chinook salmon, *Oncorhynchus tshawytscha*, creel survey, effort, harvest, migratory timing, sibling ratios, brood tables.

INTRODUCTION

The largest freshwater recreational fishery in Alaska occurs in the Kenai River which received an average of nearly 270,000 angler-days of effort over the years 1983-1990 (Mills 1984-1991). This represents approximately 15% of the state's recreational fishing effort. The majority of the angler-effort occurs in the section of the river between the outlet of Skilak Lake and Cook Inlet (Figure 1) during a fishery directed primarily at returning chinook salmon *Oncorhynchus tshawytscha* during May, June, and July.

It has been long recognized that the Kenai River has two stocks of chinook salmon: (1) an early run which enters the river from mid-May through June, and (2) a late run which enters the river from late June through early August (Burger et al. 1985, Bendock and Alexandersdottir 1991). Early-run fish are destined primarily for tributary spawning locations although some mainstem spawning also occurs. Late-run fish are destined almost exclusively for mainstem spawning locations. The focus of this report is the early run.

Prior to 1970, the recreational fishery in the Kenai River was comprised of shore-based anglers targeting on sockeye salmon *O. nerka* in July and coho salmon *O. kisutch* in August and early September. In 1973, large numbers of anglers began experimenting with a new fishing method that involved bouncing brightly colored terminal gear along the river bottom from a drifting boat. This technique had been used effectively by anglers fishing for chinook salmon on rivers in the Pacific Northwest. It proved to be a very effective method for catching chinook salmon on the Kenai River, and the fishery began to expand rapidly (Figure 2).

The Alaska Department of Fish and Game, Division of Sport Fish, initiated creel surveys for this fishery in 1974 (Hammarstrom 1975). A comprehensive stock assessment program was initiated in 1985 and included estimates of inriver return (Hammarstrom and Larson 1986). By 1988, continued growth of both early- and late-run fisheries had heightened both agency and public concerns that stocks were vulnerable to overexploitation. In response to this concern, the Board of Fisheries (BOF) in 1988 adopted management plans for the early- and late-run returns of chinook salmon to the Kenai River (McBride et al. 1989). These plans stipulate both: (1) specific escapement goals for which the fisheries in question will be managed, and (2) the manner in which selected fisheries are to be managed in the event of conservation shortfall. These fisheries have been managed under the auspices of these management plans since 1989.

The objectives of the department's stock assessment program are two-fold. First, return statistics are compiled to assess production and include estimates of harvest and abundance by age. Second, run timing is modeled to implement the escapement goal policy and includes migratory timing estimates of effort, harvest, and abundance.

In this report, I present statistics for the 1991 early-run return, including estimates of inriver return, fishery parameters, and escapement. These estimates are compared to historic performance and their application to the 1991 return is discussed. Finally a forecast of the 1992 return is presented.

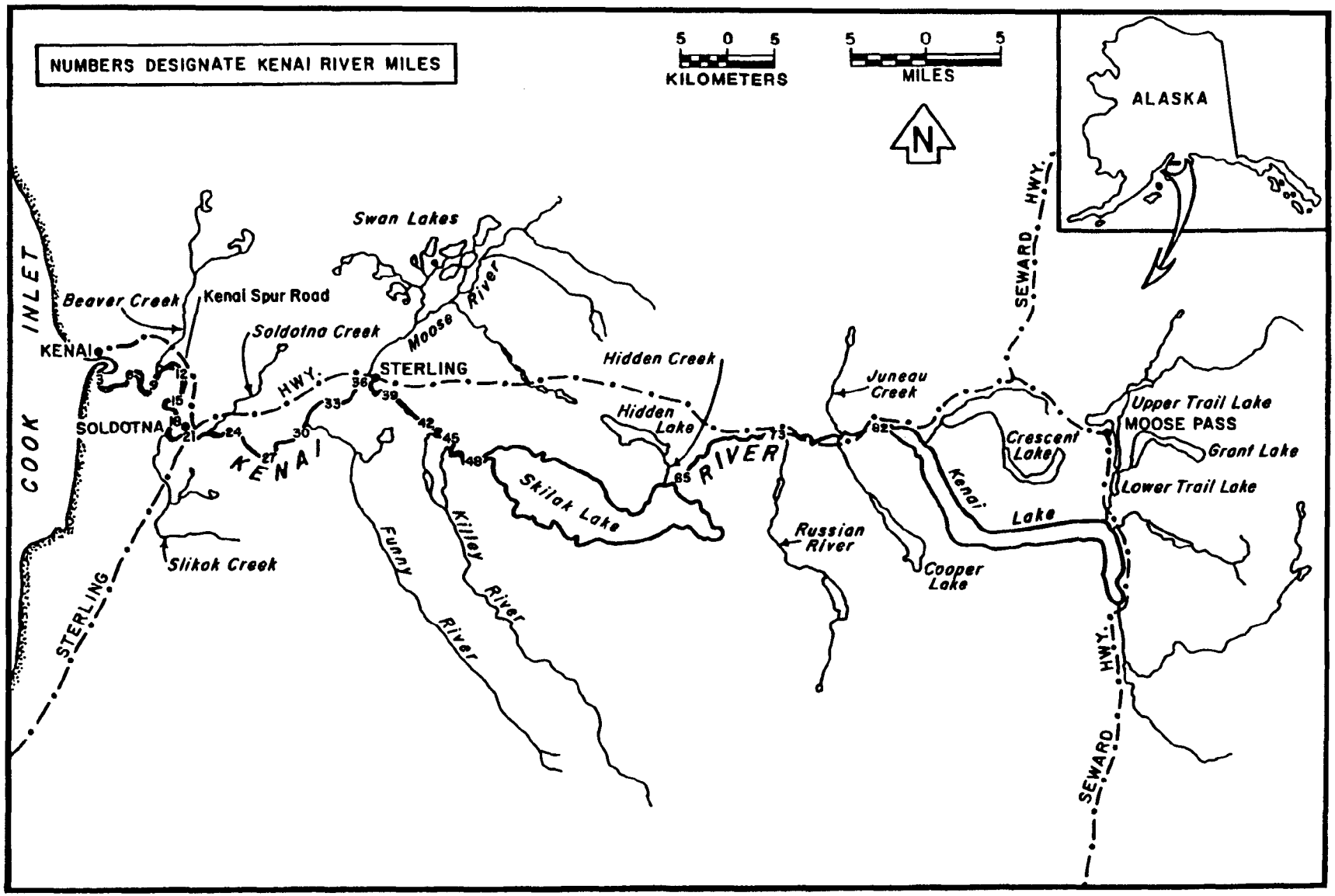

Figure 1. Map of Kenai River drainage.

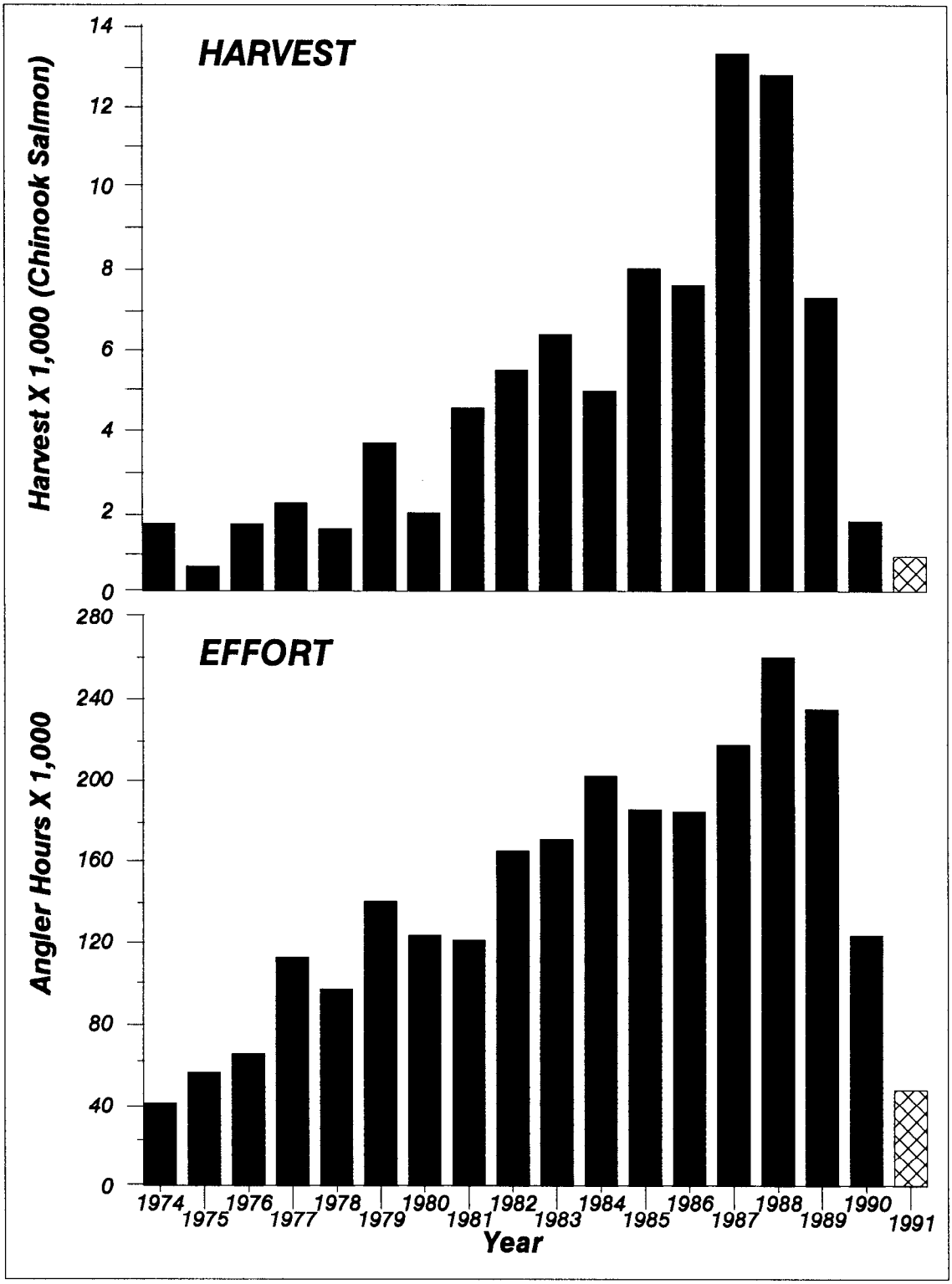

Figure 2. Historical harvest and effort in the recreational fishery for early-run chinook salmon, Kenai River, 1974-1991.

Previous information pertaining to the chinook salmon fisheries in the Kenai River has been presented by Hammarstrom (1975-1981, 1988-1991), Hammarstrom and Larson (1982-1984, 1986), Hammarstrom et al. (1985), and Conrad and Hammarstrom (1987). Details of the 1992 creel survey of the recreational fishery are reported by Hammarstrom (*In prep*). In addition, angler-effort and harvest by species for the recreational fishery has been estimated by Mills (1979-1991) via postal questionnaire. Rationale for the escapement goals and migratory timing data to implement the management plans are contained in McBride et al. (1989). Bendock and Alexandersdottir (1991) estimated hooking mortality for the Kenai River chinook salmon recreational fisheries. Estimates of total return by age have been summarized through 1990 by Sonnichsen and Alexandersdottir (1991).

METHODS

Fishing Regulations

As mentioned above, the recreational chinook salmon fisheries on the Kenai River are conducted under the guidance of the Early and Late King Salmon Management Plans. Early-run chinook salmon are considered to be those fish that enter the system prior to 1 July. From 1 January until an optimum spawning escapement level of 9,000 can be projected, the use of bait is prohibited. If the projected spawning escapement is between 5,300 and 9,000, the department shall, by emergency order, restrict the fishery through bag limit reduction and/or time/area closure to achieve 9,000 fish in the escapement. If the projected escapement is less than 5,300, chinook salmon fishing is to be prohibited until 1 July downstream of the Funny River and 10 July upstream of the Funny River (Figures 1 and 3).

The regulations for the chinook salmon fishery in the Kenai River are the most restrictive of any in Alaska. Only the mainstem Kenai River between the outlet of Skilak Lake and Cook Inlet (Figure 1) is open to fishing for chinook salmon. By regulation, the season for chinook salmon is from 1 January through 31 July, but it effectively begins in mid-May when the fish first begin entering the river. The daily bag and possession limits are one chinook salmon per day greater than 41 cm (16 in) total length and a seasonal limit of two chinook salmon greater than 41 cm. In 1991, fishing from boats downstream from the outlet of Skilak Lake was prohibited on Mondays in May and June except Monday of Memorial Day. Anyone retaining a chinook salmon that was 41 cm in length or greater was prohibited from fishing from a boat in the Kenai River for the remainder of that day. Additionally, the early-run fishery was further restricted in that the use of bait was prohibited until the department was able to project an escapement of at least 9,000 fish, which occurred on 28 June this past season.

There were further restrictions for guided anglers. In 1991, fishing from a guided boat was allowed only between 0600 and 1800 hours during June. There was no time restriction on anglers using guides during May.

The early-run management plan was amended by the BOF for implementation during the 1991 season to provide for retention of large fish, 132 cm (52 inches) or larger, if hook and release fishing was imposed. This regulation, along with numerous other changes adopted by the BOF at its 1990 meeting, were not

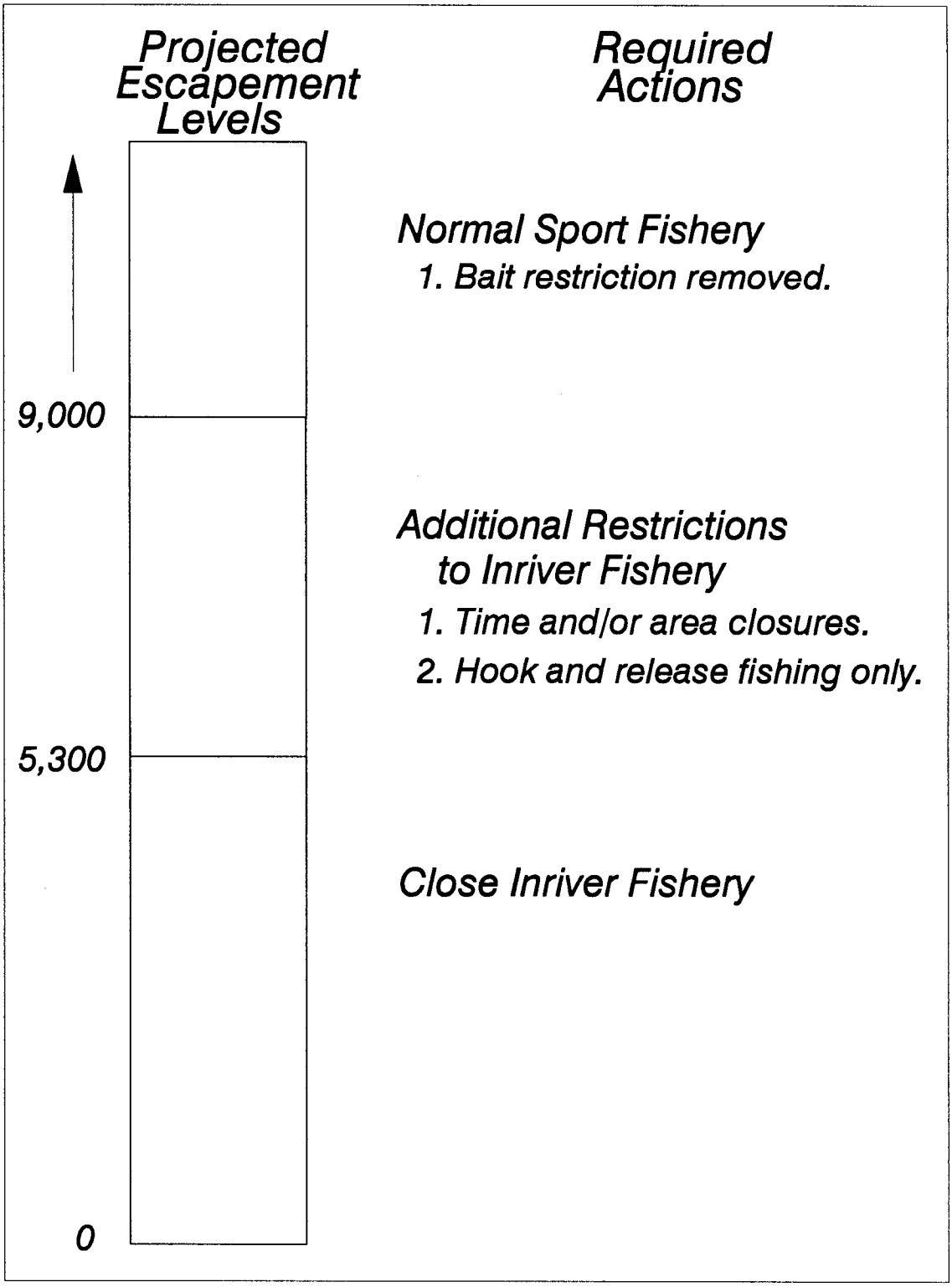

Figure 3. Escapement levels and required actions according to the Kenai River Early Run Chinook Salmon Management Plan.

enforceable until 21 July because of legal complications in the process of turning board action into regulation.

In 1991, a subsistence gill net fishery was to take place in selected marine waters of Cook Inlet that had the potential of impacting the Kenai River chinook salmon return. Various court challenges and legal complications resulted in minimal effort during 1991, causing no impact.

Stock Assessment

Early-run Kenai River chinook salmon are assessed at several locations on their spawning migration. As these fish enter Cook Inlet, they are mixed with other stocks of chinook salmon from numerous natal streams including the Anchor River, Deep Creek, Ninilchik River, Stariski Creek, Kasilof River, and the Susitna River drainage. Since the 1980s, Susitna River stocks routinely outnumber the early-run Kenai River stock by an order of magnitude (McBride et al. 1985). During May and June, the recreational marine fishery along the eastern shore of Cook Inlet in the vicinity of Ninilchik Village accounts for the only significant harvest in marine water of these stocks. The harvest in this fishery during the period that early-run Kenai River chinook salmon would be present (May and June) has averaged approximately 2,500 fish since 1972 (Hammarstrom and Larson 1986, Hammarstrom et al. 1987, Mills 1988-1991, Sonnichsen and Alexandersdottir 1991). Based on the above information, it is unlikely that estimation of the contribution of Kenai River stocks to this marine fishery during May and June would alter any conclusions regarding stock status (McBride et al. 1989) and therefore has not been accounted for.

From Ninilchik Village to the Kenai River, the migration is relatively unimpeded. A single net educational fishery for members of the Kenaitze Indian tribe has been authorized since 1989, but has accounted for fewer than 100 fish annually. In 1991, a subsistence gill net fishery was established by the BOF, however, various legal complications and challenges precluded any significant impact to the returning fish this past year.

The inriver return has been estimated annually since 1985. Two methods have been employed: (1) a tag/recapture program from 1985-1990 (Hammarstrom and Larson 1986, Conrad and Larson 1987, Conrad 1988, Carlon and Alexandersdottir 1989, Alexandersdottir and Marsh 1990), and (2) a hydroacoustic (sonar) program from 1984-1991 (Burwen and Skvorc *In prep* 1989 data, Burwen and Skvorc *In prep* 1990 data, Burwen and Skvorc *In prep* 1991 data). Since 1987, sonar has provided the best estimate of the inriver return. The tag/recapture project was not conducted in 1991. Since 1985, the inriver return has averaged 18,467 fish.

Of critical importance is an estimate of the age, sex, and size composition of the inriver return. Prior to 1991, scale samples collected from chinook salmon captured with large mesh gill nets for the tag/recapture study provided the samples for this analysis. In 1991, the techniques employed for that study were continued, however, the personnel requirements were halved since tags were no longer released and the sample size required could still be achieved. The result of this component is an estimate of the numbers of chinook salmon by age entering the river.

As these fish continue on their migration, they encounter Alaska's largest freshwater recreational fishery that occurs from approximately river mile 8 (river kilometer 13) to river mile 50 (river kilometer 81). Harvest of chinook salmon in this fishery has been estimated through a creel survey since 1974 and the catch has been estimated only since 1986 (Hammarstrom 1975-1981, 1988-1991, *In prep*; Hammarstrom and Larson 1982-1984, 1986; Hammarstrom et al. 1985; Conrad and Hammarstrom 1987). Release mortality is accounted for and estimated at 6.4% for early-run fish (Bendock and Alexandersdottir 1991, 1992). The age, sex, and size composition of the harvest is estimated from samples collected from the recreational fishery as part of the angler interviews conducted in the creel survey (Hammarstrom 1991). The age composition mortalities attributed to hook and release fishing were assumed to be equal to that determined for the harvest. There is an undefined bias introduced in that smaller fish tend to be released more often than larger fish and small males tend to suffer higher mortality than large males or females (Bendock and Alexandersdottir 1991); however, the numbers of fish that succumb to hook and release fishing were relatively small and would not alter conclusions regarding production. The result of the creel survey is an estimate of the number of fish, by age and sex, removed from the spawning population as a direct result of recreational fishing.

To clarify terms, inriver return refers to all fish that are counted past the sonar in the Kenai River. Total return refers to all early-run Kenai River chinook salmon harvested in upper Cook Inlet marine fisheries plus the inriver return. Sport marine harvests of early run Kenai River chinook salmon are believed to be small and are unaccounted for. The only source of fishing mortality currently accounted for below the sonar site is the subsistence harvest in the educational fishery. Escapement (fish that survive all fisheries and are potential spawners) is estimated by subtracting total mortality from the recreational fishery (harvest plus hook and release mortalities) from the inriver return.

Brood and Sibling Relationships

Chinook salmon in the Kenai River are managed to achieve optimum sustained production. In 1988, spawning requirements were computed to sustain levels of production realized during the years 1984 to 1988 and were based on limited information from the Kenai River and the experience of other researchers working with chinook salmon on the North American west coast (McBride et al. 1989). Total return data are being compiled to assess production and refine these escapement goals. Analysis of production from any escapement requires assimilation of returns by age class from that brood. Classic analysis of production from various levels of escapement will require data that spans decades. For Kenai River chinook salmon, assessment of any year's spawning escapement requires annual return data out to 8 years of age.

A predictable relationship between consecutive-year returns of the same brood (i.e., sibling relationships) has been established for the early-run stock (Sonnichsen and Alexandersdottir 1991). Estimation of sibling ratios (the ratio of one age to one or more younger ages in a brood year) were used to forecast expected returns for future years. By using mean sibling ratios of those years for which complete return data are available, models were developed to predict the returns for 1990 and 1991 (Sonnichsen and

Alexandersdottir 1991). These models were updated with the analysis of the 1991 return and a forecast for the 1992 return was developed.

Migratory Timing

The following databases were used to estimate migratory timing of the chinook salmon return to the Kenai River: (1) inriver return, measured by daily gill net CPUE for 1985 and 1986 and by daily sonar counts for 1987-1991, (2) inriver recreational fishery statistics to include effort, harvest per hour (HPUE), catch per hour (CPUE), harvest, and catch.

Historic cumulative daily proportions of each of these statistics were used to generate migratory timing models of each parameter that were applied to data from the year in question to predict season-end values (McBride et al. 1989). Cumulative daily proportions of the inriver return for the years 1985-1990 were averaged to formulate the model that projected total inriver return for 1991 (Appendix A1). Cumulative daily proportions of recreational effort, HPUE, and CPUE for the years 1984-1990 were averaged to generate the model that projected the harvest and catch for 1991 (Appendices A2-A11).

On a daily basis, inriver return was projected by dividing the 1991 cumulative sonar count by the historic mean cumulative proportion through that same date. Similarly, harvest and catch were also projected. Escapement was projected by subtracting the projected fishing mortality (harvest plus hook and release mortality) from the projected inriver return. Although projections are made from the commencement of the fishery, precision of estimates is insufficient to detect significant deviations from historic performance until early June.

ASSESSMENT OF THE 1991 EARLY RETURN OF CHINOOK SALMON TO THE KENAI RIVER

Inriver Return

Sonar equipment was activated 16 May and operated continually through the early run (Burwen and Skvorc *In prep* 1991 data). Inriver return through 30 June was 10,931 fish (Table 1). The 1991 return was slightly larger than the 1990 return but significantly smaller than the returns of 1985-1989[1].

A total of 232 chinook salmon were captured in the gill net test fishery during the early run (Table 2). The inriver return was comprised predominantly of age 1.4 (65.1%) followed by age classes 1.3, 1.2, and 1.5, (22.4%, 7.3%, and 5.2%, respectively). The 1991 allocation of the inriver return by age along with the historical age composition (1986-1990) appears in Table 3.

Recreational Fishery

The 1991 recreational fishery started approximately 1 week later than normal due to unusually low water levels in May and the creel survey did not commence until 24 May; normal start date is 16 May (Hammarstrom *In prep*). A relatively weak return prompted an emergency order closure of the fishery to retention of

[1] Inriver returns were estimated with tagging data in 1985 (15,972) and 1986 (27,080). See Table 10 for a summary of all return data.

Table 1. Historical sonar counts of chinook salmon in the Kenai River during the early run, 1987-1991.

	1987		1988		1989		1990		1991	
Date	Daily Counts	Cum Counts	Daily Counts	Cum Counts	Daily Counts	Cum Counts	Daily Counts	Cum Counts	Daily Counts	Cum Counts
5/16			188	188	180	180	78	78	30	30
5/17			415	603	319	499	57	135	12	42
5/18			259	862	264	763	93	228	65	107
5/19			260	1,122	180	943	136	364	55	162
5/20			406	1,528	147	1,090	93	457	68	230
5/21			184	1,712	245	1,335	69	526	51	281
5/22			182	1,894	164	1,499	75	601	111	392
5/23			231	2,125	186	1,685	63	664	66	458
5/24			288	2,413	279	1,964	51	715	66	524
5/25			351	2,764	300	2,264	76	791	57	581
5/26			393	3,157	270	2,534	70	861	81	662
5/27			387	3,544	419	2,953	87	948	81	743
5/28			483	4,027	357	3,310	61	1,009	78	821
5/29			713	4,740	269	3,579	144	1,153	51	872
5/30			333	5,073	164	3,743	138	1,291	51	923
5/31			501	5,574	157	3,900	173	1,464	69	992
6/01			556	6,130	258	4,158	153	1,617	150	1,142
6/02			545	6,675	194	4,352	303	1,920	240	1,382
6/03			598	7,273	233	4,585	235	2,155	362	1,744
6/04	1,059	1,059	755	8,028	246	4,831	177	2,332	177	1,921
6/05	552	1,611	782	8,810	280	5,111	192	2,524	316	2,237
6/06	1,495	3,106	493	9,303	384	5,495	156	2,680	290	2,527
6/07	1,145	4,251	506	9,809	545	6,040	304	2,984	215	2,742
6/08	602	4,853	771	10,580	890	6,930	415	3,399	244	2,986
6/09	1,024	5,877	569	11,149	912	7,842	330	3,729	447	3,433
6/10	985	6,862	333	11,482	913	8,755	270	3,999	281	3,714
6/11	1,004	7,866	320	11,802	710	9,465	453	4,452	335	4,049
6/12	1,044	8,910	302	12,104	577	10,042	569	5,021	388	4,437
6/13	2,168	11,078	188	12,292	599	10,641	444	5,465	360	4,797
6/14	1,297	12,375	289	12,581	458	11,099	330	5,795	272	5,069
6/15	975	13,350	510	13,091	335	11,434	651	6,446	432	5,501
6/16	786	14,136	808	13,899	397	11,831	486	6,932	610	6,111
6/17	612	14,748	535	14,434	514	12,345	277	7,209	335	6,446
6/18	783	15,531	533	14,967	464	12,809	238	7,447	494	6,940
6/19	771	16,302	200	15,167	295	13,104	332	7,779	440	7,380
6/20	682	16,984	175	15,342	498	13,602	369	8,148	317	7,697
6/21	517	17,501	373	15,715	520	14,122	256	8,404	454	8,151
6/22	487	17,988	312	16,027	614	14,736	265	8,669	438	8,589
6/23	529	18,517	375	16,402	547	15,283	240	8,909	398	8,987
6/24	303	18,820	674	17,076	564	15,847	322	9,231	250	9,237
6/25	564	19,384	582	17,658	374	16,221	258	9,489	225	9,462
6/26	731	20,115	436	18,094	369	16,590	322	9,811	271	9,733
6/27	452	20,567	549	18,643	309	16,899	231	10,042	340	10,073
6/28	587	21,154	827	19,470	425	17,324	236	10,278	330	10,403
6/29	371	21,525	495	19,965	376	17,700	208	10,486	258	10,661
6/30	388	21,913	915	20,880	292	17,992	193	10,679	270	10,931
TOTAL		21,913		20,880		17,992		10,679		10,931

Table 2. Estimates by age class of the number of early-run chinook salmon in the inriver return to the Kenai River, 1991.

	Age Class				
	1.2	1.3	1.4	1.5	Total
Males					
Sample Size	17	30	51	5	103
Percent	7.3	12.9	22.0	2.2	44.4
SE Percent	1.7	2.2	2.7	1.0	3.3
Return	801	1,413	2,403	236	4,853
SE Return	187	241	298	104	357
Females					
Sample Size	0	22	100	7	129
Percent	0.0	9.5	43.1	3.0	55.6
SE Percent	0.0	1.9	3.3	1.1	3.3
Return	0	1,037	4,712	330	6,079
SE Return	0	211	356	123	357
Combined					
Sample Size	17	52	151	12	232
Percent	7.3	22.4	65.1	5.2	100.0
SE Percent	1.7	2.7	3.1	1.5	
Return	801	2,450	7,115	565	10,931
SE Return	187	300	343	159	

Table 3. Estimates by age class of the number of early-run chinook salmon in the total return to the Kenai River, 1986-1991.

	Age Class									
	1.1	1.2	1.3	1.4	1.5	1.6	2.2	2.3	2.4	Total
1986										
Percent	0.0	16.8	43.3	32.8	7.0	0.0	0.0	0.0	0.0	100.0
Return	0	4,554	11,731	8,880	1,908	0	0	0	7	27,080
SE Return	0	1,755	4,239	3,195	703	0	0	0	12	9,799
1987										
Percent	0.0	1.5	37.6	58.0	2.3	0.0	0.0	0.1	0.4	100.0
Return	0	386	9,653	14,883	589	0	0	31	101	25,643
SE Return	0	125	2,080	3,732	226	0	0	31	56	5,928
1988										
Percent	0.0	1.7	14.8	72.2	10.9	0.3	0.0	0.1	0.0	100.0
Return	0	358	3,088	15,077	2,279	57	0	21	0	20,880
SE Return	0	97	260	335	237	40	0	21	0	0
1989										
Percent	0.0	4.2	15.8	70.8	9.2	0.0	0.0	0.0	0.0	100.0
Return	0	759	2,853	12,788	1,665	0	0	0	0	18,065 [a]
SE Return	0	137	250	311	195	0	0	0	0	0
1990										
Percent	0.0	7.4	26.1	60.5	6.0	0.0	0.0	0.0	0.0	100.0
Return	0	800	2,819	6,541	648	0	0	0	0	10,808 [b]
SE Return	0	133	214	241	114	0	0	0	0	0
1991										
Percent	0.0	7.3	22.4	65.1	5.2	0.0	0.0	0.0	0.0	100.0
Return	0	801	2,450	7,117	565	0	0	0	0	10,933 [c]
SE Return	0	187	300	343	159	0	0	0	0	0

[a] Includes 73 fish harvested in the Kenaitze educational gill net fishery.
[b] Includes 40 fish harvested in the Kenaitze educational gill net fishery.
[c] Includes 2 fish harvested in the Kenaitze educational gill net fishery.

chinook salmon on 6 June. A portion of the fishery was reopened to retention on 28 June and included the area from Slikok Creek to Cook Inlet (Figure 1). Chinook salmon fishing was closed upstream of this point until 15 July to protect early-run fish that were holding in the mainstem prior to entering tributary streams to spawn. This was the second consecutive year that hook and release fishing had been imposed during the early run.

Angler effort during the fishery for early-run chinook salmon was estimated at 47,599 angler-hours (SE = 2,258) (Hammarstrom *In prep*). Estimated harvest was the second lowest recorded at 891 (SE = 169) with an estimated catch of 3,716 (SE = 426). Anglers employing professional guides accounted for 67% of the harvest and 49% of the effort (Table 4).

A total of 47 fish with readable scales were sampled from the recreational harvest. The majority of the harvest was age class 1.4 (81%) (Table 5). Historical comparison of the age and sex composition of the early run harvest is presented in Table 6 (1976-1991).

Prior to imposition of mandatory hook and release fishing in 1990, anglers released approximately one-third of their catch. During 1990 and 1991, nearly two-thirds of the catch was released. In 1991, release mortality was estimated at 116 (SE = 92) fish. Historical hook and release mortality estimates are presented in Table 7.

Escapement and Total Return

Spawning escapement was estimated by subtracting total fishing mortality from the inriver return. In 1991, an estimated 9,924 chinook salmon escaped all fisheries as potential spawners (Table 8). The majority of these spawners were age class 1.4. This age class has been the predominant spawning age class since 1987. Historical (1986-1991) age composition of the spawning escapement is presented in Table 9.

In 1991, the only additional harvest of early-run Kenai River chinook salmon was in the educational/subsistence gill net fishery in Cook Inlet near the mouth of the Kenai River. This was the third year of the educational fishery conducted by the Kenaitze Indian Tribe. Only two chinook salmon were reported in 1991. This compares to 73 in 1989 and 40 in 1990. Although not required, the tribal members voluntarily ceased fishing during most of the period hook and release fishing was in effect. In essence, the total return of early-run chinook salmon is the same as the inriver return measured by sonar. Age composition of the total return appears in Table 3. Table 10 presents the historical composition of the early return to the Kenai River, 1985-1991.

Brood Relationships

Age components of measured returns are presented in Table 11 and a summary of the production from each brood year appears in Table 12. Total production from the first measured escapement (8,001 fish in 1985) will not be estimated until 1993. Nevertheless, it appears that performance from both the 1985 and 1986 escapements will be little better than replacement (Table 12).

Table 4. Historical summary of harvest, angler effort, and harvest rate in the recreational fishery for early-run chinook salmon, Kenai River, 1974-1991.

	Harvest			Effort in Angler Hours			Harvest per Hour		
Year	Unguided	Guided	Total	Unguided	Guided	Total	Unguided	Guided	Total
1974			1,685			41,098			0.041
1975			615			55,909			0.011
1976			1,665			64,750			0.026
1977			2,173			112,007			0.019
1978			1,542			96,624			0.016
1979			3,661			139,154			0.026
1980			1,946			123,019			0.016
1981	2,278	2,247	4,525	92,837	28,044	120,881	0.025	0.080	0.037
1982	3,002	2,464	5,466	136,560	27,774	164,334	0.022	0.089	0.033
1983	2,274	4,086	6,360	121,208	48,789	169,997	0.019	0.084	0.037
1984	2,396	2,560	4,956	153,586	48,235	201,821	0.016	0.053	0.025
1985	3,191	4,780	7,971	126,243	58,593	184,836	0.025	0.082	0.043
1986	3,575	3,986	7,561	134,868	49,033	183,901	0.027	0.081	0.041
1987	6,899	6,382	13,281	160,839	55,977	216,816	0.043	0.114	0.061
1988	5,791	6,956	12,747	181,436	78,465	259,901	0.032	0.089	0.049
1989	1,952	5,304	7,256	132,282	102,245	234,527	0.015	0.052	0.031
1990 [a]	367	1,368	1,735	57,189	65,960	123,149	0.010	0.038	0.024
Mean	3,173	4,013	5,009	129,705	56,312	146,631	0.023	0.076	0.032
1991	298	593	891	24,320	23,279	47,599	0.020	0.043	0.031

[a] Harvest per hour only for periods open to retention of chinook salmon.

Table 5. Estimates by age class of the number of early-run chinook salmon harvested in the recreational fishery on the Kenai River, 1991.

	Age Class				
	1.2	1.3	1.4	1.5	Total
Males					
Sample Size	0	1	13	2	16
Percent	0.0	2.1	27.7	4.3	34.0
SE Percent	0.0	2.1	6.6	3.0	7.0
Harvest	0	19	246	38	303
SE Harvest	0	19	74	27	84
Females					
Sample Size	0	3	25	3	31
Percent	0.0	6.4	53.2	6.4	66.0
SE Percent	0.0	3.6	7.4	3.6	7.0
Harvest	0	57	474	57	588
SE Harvest	0	33	111	33	127
Combined					
Sample Size	0	4	38	5	47
Percent	0.0	8.5	80.9	10.6	100.0
SE Percent	0.0	4.1	5.8	4.5	
Harvest	0	76	720	95	891
SE Harvest	0	39	146	44	169

Table 6. Estimates by age class of the number of early-run chinook salmon harvested in the recreational fishery on the Kenai River, 1976-1991.

	Age Class										
	1.1	1.2	1.3	1.4	1.5	1.6	2.3	2.4	2.5	Other	Total
1976											
Percent	3.9	26.4	24.0	42.2	2.4	0.0	1.0	0.0	0.0		100.0
Harvest	61	411	373	656	38	0	15	0	0		1,554
SE Harvest	21	48	47	54	17	0	11	0	0		
1977											
Percent	0.0	14.1	29.6	52.4	1.5	0.0	0.5	1.5	0.5		100.0
Harvest	0	306	643	1,138	32	0	11	32	11		2,173
SE Harvest	0	53	69	76	18	0	11	18	11		
1978											
Percent	0.0	16.0	18.9	65.2	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Harvest	0	246	291	1,005	0	0	0	0	0	0	1,542
SE Harvest	0	68	73	89	0	0	0	0	0	0	
1979											
Percent	5.8	30.8	51.9	11.5	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Harvest	154	819	1,381	307	0	0	0	0	0	0	2,661
SE Harvest	0	61	121	131	84	0	0	0	0	0	
1980											
Percent	0.0	9.0	14.9	69.8	6.3	0.0	0.0	0.0	0.0	0.0	100.0
Harvest	0	175	289	1,359	123	0	0	0	0	0	1,946
SE Harvest	0	37	47	60	32	0	0	0	0	0	
1981											
Percent		14.2	31.0	49.5	3.1					2.2	100.0
Harvest		641	1,402	2,242	140					100	4,525
SE Harvest		105	139	151	52					44	

-continued-

Table 6. (Page 2 of 3).

	Age Class										
	1.1	1.2	1.3	1.4	1.5	1.6	2.3	2.4	2.5	Other	Total
1982											
Percent		6.3	23.3	62.3	4.4					3.8	100.0
Harvest		344	1,272	3,403	241					206	5,466
SE Harvest		106	184	211	89					83	
1983											
Percent		7.1	14.3	62.9	4.3					11.4	100.0
Harvest		454	909	3,998	273					726	6,360
SE Harvest		197	268	370	155					244	
1984											
Percent	0.0	3.4	27.8	61.8	6.9	0.0	0.0	0.0	0.0		100.0
Harvest	0	170	1,380	3,065	341	0	0	0	0		4,956
SE Harvest	0	53	130	141	74	0	0	0	0		
1985											
Percent	0.0	6.1	13.3	76.5	4.1	0.0	0.0	0.0	0.0		100.0
Harvest	0	488	1,058	6,100	325	0	0	0	0		7,971
SE Harvest	0	112	158	197	92	0	0	0	0		
1986											
Percent	0.2	7.1	36.3	47.5	8.9	0.0	0.0	0.0	0.0		100.0
Harvest	14	540	2,741	3,591	675	0	0	0	0		7,561
SE Harvest	14	89	229	274	100	0	0	0	0		470
1987											
Percent	0.0	0.9	31.1	62.7	4.7	0.0	0.0	0.6	0.0		100.0
Harvest	0	113	4,134	8,326	623	0	0	85	0		13,281
SE Harvest	0	57	392	621	136	0	0	49	0		871

-continued-

Table 6. (Page 3 of 3).

	Age Class										
	1.1	1.2	1.3	1.4	1.5	1.6	2.3	2.4	2.5	Other	Total
1988											
Percent	0.2	1.9	12.2	78.6	6.8	0.0	0.0	0.3	0.0		100.0
Harvest	22	244	1,555	10,016	866	0	0	44	0		12,747
SE Harvest	22	74	195	608	143	0	0	31	0		722
1989											
Percent	1.1	3.3	26.2	62.8	6.6	0.0	0.0	0.0	0.0		100.0
Harvest	79	238	1,903	4,560	476	0	0	0	0		7,256
SE Harvest	56	97	272	416	137	0	0	0	0		517
1990											
Percent	0.0	5.6	5.6	74.6	14.1	0.0	0.0	0.0	0.0		100.0
Harvest	0	98	98	1,295	244	0	0	0	0		1,735
SE Harvest	0	50	50	225	81	0	0	0	0		277
1991											
Percent	0.0	0.0	8.5	80.9	10.7	0.0	0.0	0.0	0.0		100.1
Harvest	0	0	76	720	95	0	0	0	0		891
SE Harvest	0	0	39	146	44	0	0	0	0		169

Table 7. Estimates of the number of early-run chinook salmon mortalities attributable to hook and release fishing, Kenai River, 1986-1991.

Year	Sport Catch	Sport Harvest	Number Released	SE Released	Percent Mortality [a]	SE Percent	Hook and Release Mortality	SE Mortality
1986	12,117	7,561	4,556	845	6.4 (E)	3.39	292	161
1987	19,119	13,281	5,838	1,492	6.4 (E)	3.39	374	214
1988	18,643	12,747	5,896	1,129	6.4 (E)	3.39	377	209
1989	9,901	7,256	2,645	831	6.4 (E)	3.39	169	100
1990	4,973	1,735	3,238	630	8.8 (M)	2.50	285	97
1991	3,716	891	2,825	391	4.1 (M)	1.98	116	58

[a] (E) Estimated as the mean of the 1990 and 1991 mortality rates (Bendock and Alexandersdottir 1992).

(M) Actual estimates of mortality rate for 1990 and 1991 (Bendock and Alexandersdottir 1992).

Table 8. Estimated number of early-run chinook salmon, by age group, spawning in the Kenai River, 1991.

	Age Group				
	1.2	1.3	1.4	1.5	Total
Male					
Inriver return	801	1,413	2,403	236	4,853
Recreational harvest	0	19	246	38	303
Hook & release mortality [a]	8	15	25	3	51
Escapement	793	1,379	2,132	195	4,499
Female					
Inriver return	0	1,037	4,712	329	6,078
Recreational harvest	0	57	474	57	588
Hook & release mortality [a]	0	11	50	4	65
Escapement	0	969	4,188	268	5,425
Combined					
Inriver return	801	2,450	7,115	565	10,931
Recreational harvest	0	76	720	95	891
Hook & release mortality [a]	8	26	75	7	116
Escapement	793	2,348	6,320	463	9,924

[a] Age/sex composition of released component of recreational fishery assumed equal to the age/sex composition of inriver return.

Table 9. Estimates by age class of the number of early-run chinook salmon in the spawning escapement to the Kenai River, 1986-1991.

	Age Class									Total Aged [a]	Hook and Release Mortality	Total Spawned
	1.1	1.2	1.3	1.4	1.5	1.6	2.2	2.3	2.4			
1986												
Spawning Escapement	0	4,014	8,989	5,289	1,233	0	0	0	7	19,519	292	19,227
SE Escapement	14	1,757	4,245	3,207	710	0	0	0	19	9,810	161	9,811
1987												
Spawning Escapement	0	273	5,519	6,558	0	0	0	31	16	12,362	374	11,988
SE Escapement	0	137	2,117	3,783	264	0	0	31	74	5,992	214	5,996
1988												
Spawning Escapement	0	114	1,533	5,061	1,413	57	0	21	0	8,133	377	7,756
SE Escapement	22	122	325	694	277	40	0	21	31	722	209	752
1989												
Spawning Escapement	0	518	938	8,177	1,182	0	0	0	0	10,736	169	10,567
SE Escapement	56	168	369	519	238	0	0	0	0	517	100	527
1990												
Spawning Escapement	0	699	2,710	5,222	402	0	0	0	0	9,033	285	8,748
SE Escapement	0	142	220	330	140	0	0	0	0	277	97	293
1991												
Spawning Escapement	0	801	2,374	6,395	470	0	0	0	0	10,040	116	9,924
SE Escapement	0	187	302	372	165	0	0	0	0	169	58	179

[a] For some age classes in some years the estimate of the number harvested in the sport fishery is greater than the estimate of the number in the inriver return. The spawning escapement for the age class in this case was set to zero. When this occurred, the total spawning escapement (calculated by subtracting the total sport harvest from the total inriver return) is not the sum of the spawning escapement across age classes.

Table 10. Summary of early-run Kenai River chinook salmon population data, 1985-1991.

Year	Deep Creek Marine Harvest	Eastside Set Net Harvest	Drift Gill Net Harvest	Commercial Personal Use	Subsistence[a]	Inriver Return	Kenai River Sport Harvest	Hook and Release Mortality	Escapement	Total Return
1985	Unknown	Closed	Closed			15,972	7,971	Unknown	8,001	15,972
1986	Unknown	Closed	Closed			27,080	7,561	292	19,227	27,080
1987	Unknown	Closed	Closed			25,643	13,281	374	11,988	25,643
1988	Unknown	Closed	Closed			20,880	12,747	377	7,756	20,880
1989	Unknown	Closed	Closed		73	17,992	7,256	169	10,567	18,065
1990	Unknown	Closed	Closed		40	10,768	1,735	285	8,748	10,808
1991	Unknown	Closed	Closed		2	10,931	891	116	9,924	10,933

[a] Includes harvest in Kenaitze educational gill net fishery.

Table 11. Age components of total returns of Kenai River early-run chinook salmon, 1985-1991.

Year	(0.2, 1.1) Age 3	(0.3, 1.2, 2.1) Age 4	(0.4, 1.3, 2.2) Age 5	(0.5, 1.4, 2.3) Age 6	(1.5, 2.4) Age 7	(1.6, 2.5) Age 8	Total Return
1985		990	2,125	12,219	638		15,972
1986		4,554	11,731	8,880	1,915		27,080
1987		386	9,653	14,914	690		25,643
1988		358	3,088	15,098	2,279	57	20,880
1989		759	2,853	12,788	1,665		18,065
1990		800	2,819	6,541	648		10,808
1991		801	2,450	7,117	565		10,933

Table 12. Summary of returns from each brood year, early-run Kenai River chinook salmon, 1978-1991.

Year	Spawning Escapement	Return (0.3,1.2,2.1) Age 4	(0.4,1.3,2.2) Age 5	(0.5,1.4,2.3) Age 6	(1.5,2.4) Age 7	(1.6,2.5) Age 8	Measured Return To Date	Return Per Spawner
1978					(1985) 638		638	
1979				(1985) 12,219	(1986) 1,915		14,134	
1980			(1985) 2,125	(1986) 8,880	(1987) 690	(1988) 57	11,752	
1981		(1985) 990	(1986) 11,731	(1987) 14,914	(1988) 2,279		29,914	
1982		(1986) 4,554	(1987) 9,653	(1988) 15,098	(1989) 1,665		30,970	
1983		(1987) 386	(1988) 3,088	(1989) 12,788	(1990) 648		16,910	
1984		(1988) 358	(1989) 2,853	(1990) 6,541	(1991) 565		10,317	
1985	8,001	(1989) 759	(1990) 2,819	(1991) 7,117			10,695	1.34
1986	19,227	(1990) 800	(1991) 2,450				3,250	0.17
1987	11,988	(1991) 801					801	0.07
1988	7,756							
1989	10,567							
1990	8,748							
1991	9,924							

Sibling Relationships

Sonnichsen and Alexandersdottir (1991) developed a sibling model to forecast future returns (Table 13). Total return for the 1990 early run was forecast at 14,919 fish; the observed value was 10,808 or 72% of the expected value (Table 14). Using similar techniques, but including values observed in 1990, they predicted a return of 14,290 for 1991. The observed value was 10,933 or 77% of the expected value.

Incorporating the observed 1991 values into the equations results in an expected return in 1992 of 12,917 chinook salmon to the Kenai River during the early run (Table 14).

One area that Sonnichsen and Alexandersdottir (1991) examined was the relationship between age 5 and age 6 fish at different return levels. These two age groups have contained the majority of chinook salmon returning to the Kenai River. Their analysis suggests that at lower abundance levels, the ratio of 5s to 6s is greater. From the 1981 and 1982 brood year, fish that returned as age 5 numbered 11,731 and 9,653, respectively. The following year's age 6s returned at a ratio of 1.3 and 1.6, respectively. For the brood years 1983-1985, age 6s returned at ratios of 4.1, 2.3, and 2.5, respectively. These ratios occurred at levels of age-5 fish of 3,088, 2,853, and 2,819, respectively (Figure 4). The return of age 5s from the 1986 brood was 2,449. If the assumption of a greater return ratio occurs for lower abundance levels holds true, the forecasted return of age 6s in 1992 is 7,265 (using the mean age 5 to age 6 ratio from brood years 1983-1985). This is not significantly different from the projection using the combined age 4 plus age 5 to age 6 ratio.

MIGRATORY TIMING AND IMPLEMENTATION OF THE MANAGEMENT PLAN

In 1988, the Board of Fisheries adopted the Kenai River Early King Salmon Management Plan which put into regulation escapement levels and the procedures by which the recreational fisheries would be managed to achieve those levels. Implementation of the management plan hinges upon the department's ability to project the strength of the return with confidence.

The key ingredient in the projection is the real time estimates of the inriver return of chinook salmon. The current hydroacoustic project provides daily estimates of chinook salmon entering the river. During May, daily counts were some of the smallest recorded since 1988 and only one daily count exceeded 100 fish (Table 1). Throughout the month of June, all daily counts exceeded 100 with the largest count (610) occurring on 16 June (Table 1).

Projections of the total inriver return declined steadily during the last 2 weeks of May (Figure 5). The 50% point of the 1991 early run was approximately 4 days later than the mean timing curve indicated. The cumulative daily proportions remained outside (later timing) the 95% confidence intervals of the model from 27 May through 21 June (Figure 6). While this trend reversed during the first week of June, it was doubtful that the size of the return would be large enough to allow the fishery to continue without additional restrictions and still meet the escapement goal of 9,000 fish. It was recommended that the recreational fishery be restricted to hook and

Table 13. Sibling return ratios for early-run Kenai River chinook salmon from brood years 1980-1986.

Brood Year	Age 5/ Age 4	Age 6/ Age 5	Age 6/ Age 4+5	Age 7/ Age 6	Age 7/ Age 5+6	Age 7/ Age 4+5+6
1980				0.08		
1981		1.27		0.15	0.09	
1982	2.12	1.56	1.06	0.11	0.07	0.06
1983	8.00	4.14	3.68	0.05	0.04	0.04
1984	7.97	2.29	2.04	0.09	0.06	0.06
1985	3.71	2.52	1.99			
1986	3.06					
Mean	4.97	2.36	2.19	0.10	0.06	0.05
SD	2.81	1.12	1.09	0.04	0.02	0.01
CV (%)	56	48	50	40	29	20
Maximum	8.00	4.14	3.68	0.15	0.09	0.06
Minimum	2.12	1.27	1.06	0.05	0.04	0.04

Table 14. Summary of expected total returns based on sibling ratios versus observed returns, early-run Kenai River chinook salmon, 1990 and 1991, and 1992 projections.

	Return				
	Age 4	Age 5	Age 6	Age 7	Total
1990					
Projected	1,514	4,576	7,616	1,213	14,919
Observed	800	2,819	6,541	648	10,808
Difference	-714	-1,757	-1,075	-565	-4,111
% of Expected	52.8	61.6	85.9	53.4	72.4
1991					
Projected	1,371	4,363	8,085	471	14,290
Observed	801	2,450	7,117	565	10,933
Difference	-570	-1,917	-968	94	-3,357
% of Expected	58.4	55.9	88.0	120.6	76.5
1992					
Projected	1,276	3,983	7,126	551	12,937
Standard Error	661	2,713	3,668	168	4,844

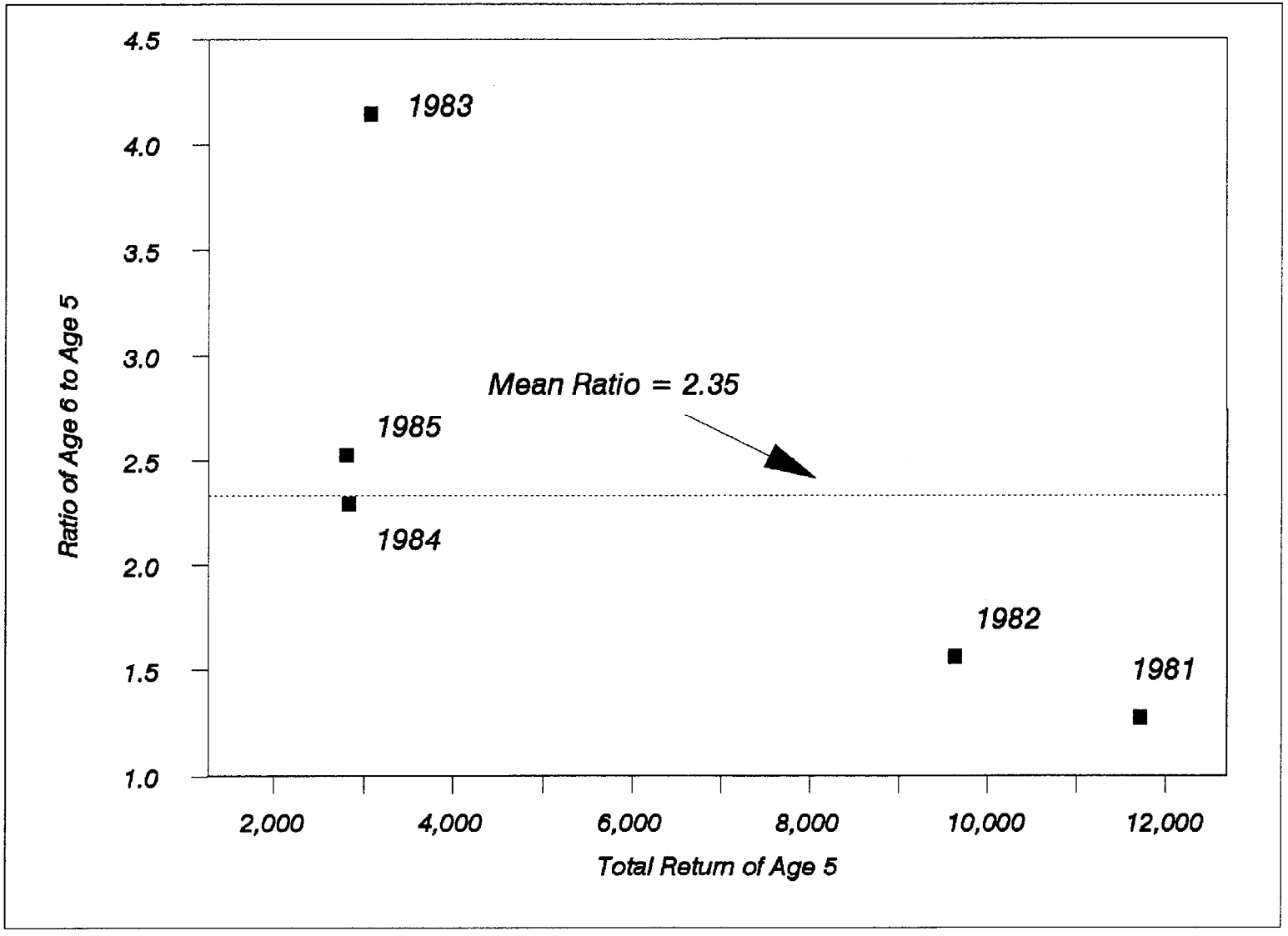

Figure 4. Ratio of the total return of age-6 chinook salmon to age 5 compared to total return of age 5 for the early run of chinook salmon into the Kenai River, 1981-1985.

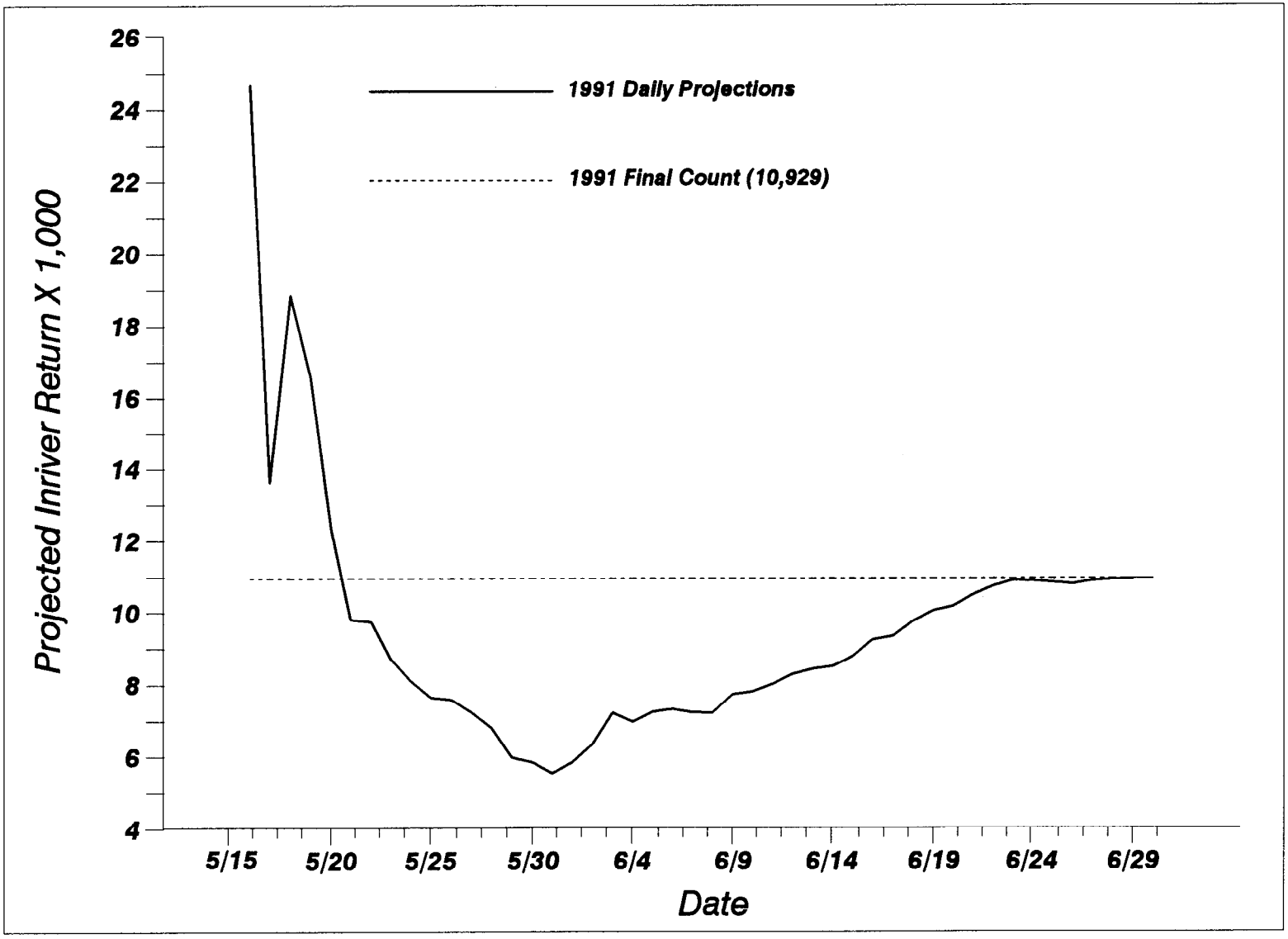

Figure 5. Daily projections of the inriver return based on historical cumulative proportions and current cumulative sonar count, Kenai River, 1991.

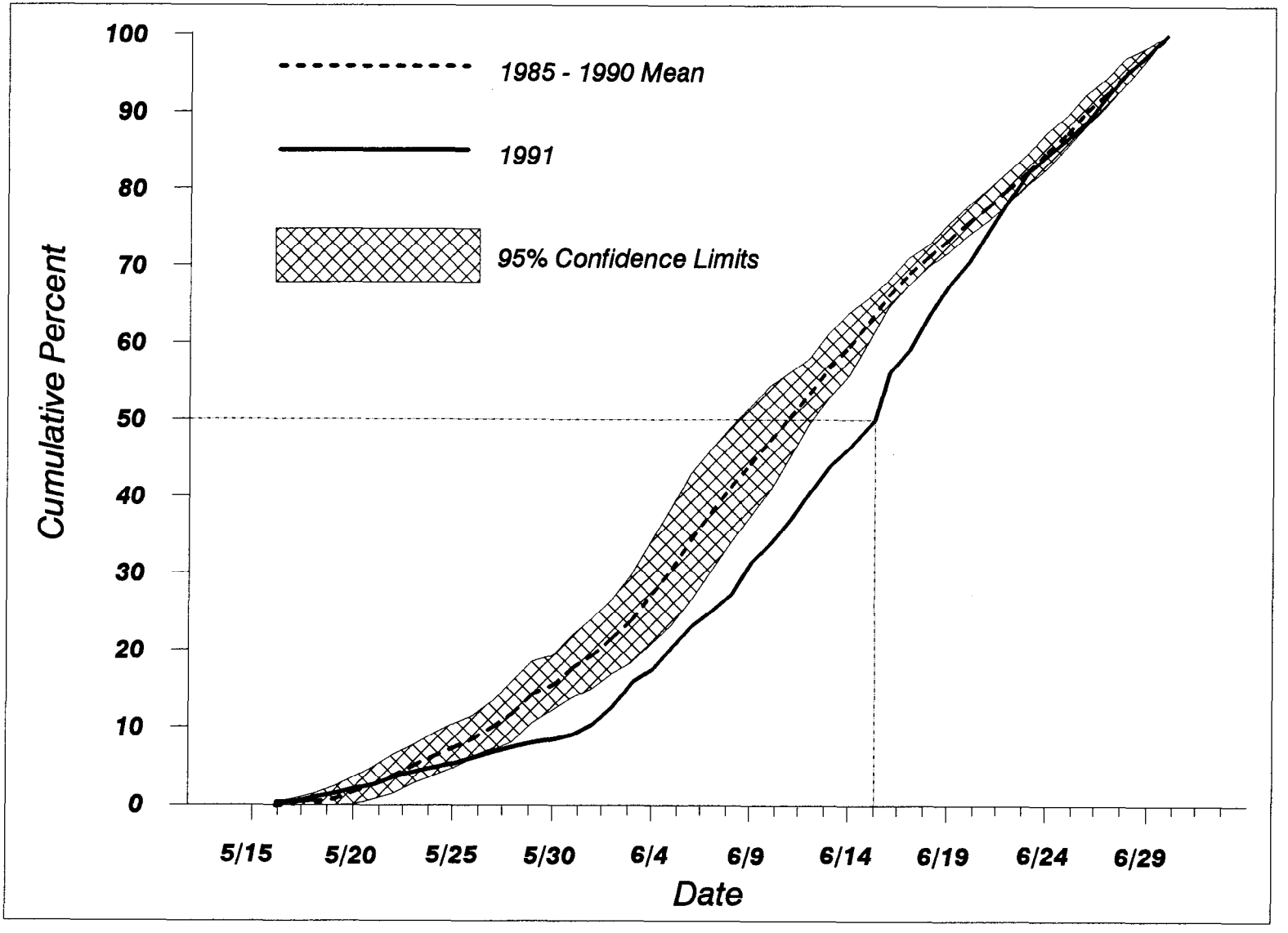

Figure 6. Cumulative percent by date of inriver return of early-run chinook salmon, Kenai River, 1985-1990 mean versus 1991.

release fishing until such time that achieving the escapement goal could be assured. By the last week of June, the return had increased sufficiently to allow retention and the fishery reopened downstream of Slikok Creek.

Despite the increase in projections during the first week of June, the fishery was restricted to catch and release only on 6 June. This restriction was lifted on 28 June only for that portion of the fishery below Slikok Creek (Figure 1).

DISCUSSION

With each year's data from the sonar project, confidence in the reliability of the equipment is enhanced. The information gathered has allowed analysis that would otherwise be improbable. The ability to get real time estimates of the inriver return has greatly improved the department's ability to react to changing situations on relatively short notice. Being able to offer hook and release fishing as an alternative to total closure in response to a relatively weak return would be less likely without this hydroacoustic project. During both 1990 and 1991, restrictions were placed on the recreational fishery in time to achieve the spawning escapement goal for early-run chinook salmon.

Timely estimates of harvest and inriver return allows for the relatively precise management techniques that are employed and required by the management plan under which the recreational fishery is conducted. Observations by survey personnel have been beneficial in documenting changes in the recreational fishery. For example, in 1990 when the fishery reopened to retention and to the use of bait on 1 July, many anglers migrated to the area upstream of the Soldotna Bridge to target on early-run fish that were staging off the mouths of tributary streams. This resulted in a significant harvest of early-run fish that were intended to be protected. This pattern of fishing was different from any that had been observed in the past. This increased harvest reduced spawning escapement to slightly below the 9,000 fish goal. When confronted with a similar situation in 1991, that portion of the river where the early-run fish were again staging prior to entering the tributaries to spawn was not reopened until 15 July. By this date, virtually the entire early run had moved out of the mainstem Kenai River and into the spawning tributaries. Run size for each year, 1990 and 1991, was virtually identical, however, nearly 1,200 additional fish reached the spawning grounds in 1991. Most of the difference can be explained by the additional harvest that occurred above the Soldotna Bridge.

The largest potential problem in the stock assessment program is the inability to account for contributions of early-run Kenai River chinook salmon to the marine sport fishery. While not believed to be a problem to date, this fishery is growing and harvests of Kenai River fish could become significant.

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APPENDIX A

Supporting statistics used to prepare the migratory timing model for the return of early-run chinook salmon to the Kenai River and used inseason to project the inriver return and associated harvest in the recreational fishery, 1991.

Appendix A1. Historical daily cumulative proportions of the inriver return of early-run chinook salmon to the Kenai River, 1985-1991.

	Daily cumulative proportions [P(t)] by year of inriver return								95% Confidence Interval			
Date	1985	1986	1987	1988	1989	1990	Mean	SE	Low	High	Rel Pre [a]	1991
5/16	0.000	0.000	0.000	0.000	0.000	0.007	0.001	0.001	0.000	0.004	257.1%	0.003
5/17	0.000	0.001	0.000	0.000	0.005	0.013	0.003	0.002	0.000	0.008	171.6%	0.004
5/18	0.000	0.001	0.000	0.000	0.012	0.021	0.006	0.004	0.000	0.015	165.4%	0.010
5/19	0.000	0.007	0.000	0.000	0.018	0.034	0.010	0.006	0.000	0.024	147.6%	0.015
5/20	0.000	0.009	0.005	0.025	0.030	0.043	0.019	0.007	0.001	0.036	93.5%	0.021
5/21	0.009	0.011	0.015	0.052	0.036	0.049	0.029	0.008	0.008	0.049	71.4%	0.026
5/22	0.019	0.013	0.027	0.073	0.054	0.056	0.040	0.010	0.015	0.066	62.5%	0.036
5/23	0.036	0.023	0.038	0.079	0.078	0.062	0.053	0.010	0.028	0.078	47.2%	0.042
5/24	0.047	0.041	0.044	0.089	0.102	0.067	0.065	0.010	0.038	0.092	41.4%	0.048
5/25	0.067	0.056	0.044	0.101	0.116	0.074	0.076	0.011	0.048	0.105	37.4%	0.053
5/26	0.086	0.068	0.056	0.106	0.129	0.081	0.088	0.011	0.060	0.115	31.7%	0.061
5/27	0.104	0.079	0.072	0.120	0.155	0.089	0.103	0.013	0.071	0.135	31.2%	0.068
5/28	0.124	0.089	0.090	0.148	0.181	0.094	0.121	0.015	0.082	0.161	32.5%	0.075
5/29	0.136	0.116	0.132	0.182	0.204	0.108	0.146	0.016	0.106	0.186	27.4%	0.080
5/30	0.153	0.125	0.159	0.182	0.211	0.121	0.158	0.014	0.123	0.194	22.6%	0.084
5/31	0.159	0.142	0.213	0.204	0.225	0.137	0.180	0.016	0.140	0.220	22.4%	0.091
6/01	0.167	0.155	0.242	0.220	0.243	0.151	0.196	0.018	0.151	0.242	23.2%	0.104
6/02	0.178	0.173	0.265	0.255	0.262	0.180	0.219	0.019	0.170	0.267	22.1%	0.126
6/03	0.201	0.178	0.298	0.289	0.289	0.202	0.243	0.022	0.185	0.300	23.7%	0.160
6/04	0.237	0.205	0.335	0.353	0.313	0.218	0.277	0.026	0.209	0.344	24.4%	0.176
6/05	0.274	0.227	0.371	0.393	0.358	0.236	0.310	0.030	0.233	0.386	24.7%	0.205
6/06	0.318	0.267	0.427	0.411	0.414	0.251	0.348	0.032	0.265	0.431	23.9%	0.232
6/07	0.359	0.314	0.461	0.430	0.449	0.279	0.382	0.031	0.303	0.461	20.8%	0.251
6/08	0.402	0.349	0.487	0.450	0.491	0.318	0.416	0.029	0.340	0.492	18.2%	0.274
6/09	0.444	0.382	0.507	0.472	0.522	0.349	0.446	0.028	0.374	0.518	16.2%	0.314
6/10	0.481	0.434	0.521	0.491	0.560	0.374	0.477	0.027	0.408	0.545	14.4%	0.339
6/11	0.513	0.490	0.536	0.505	0.576	0.417	0.506	0.022	0.450	0.562	11.0%	0.370
6/12	0.552	0.545	0.558	0.513	0.589	0.470	0.538	0.017	0.495	0.581	8.0%	0.407
6/13	0.591	0.594	0.596	0.530	0.608	0.512	0.572	0.016	0.530	0.614	7.4%	0.440
6/14	0.611	0.629	0.631	0.559	0.625	0.543	0.600	0.016	0.559	0.640	6.8%	0.465
6/15	0.633	0.656	0.660	0.593	0.640	0.604	0.631	0.011	0.602	0.660	4.6%	0.505
6/16	0.666	0.682	0.690	0.654	0.653	0.649	0.666	0.007	0.648	0.683	2.7%	0.562
6/17	0.694	0.703	0.714	0.707	0.673	0.675	0.694	0.007	0.677	0.712	2.6%	0.592
6/18	0.716	0.717	0.728	0.731	0.701	0.697	0.715	0.006	0.701	0.729	2.0%	0.637
6/19	0.744	0.735	0.736	0.769	0.716	0.728	0.738	0.007	0.719	0.757	2.5%	0.677
6/20	0.764	0.745	0.758	0.792	0.741	0.763	0.760	0.007	0.741	0.779	2.5%	0.706
6/21	0.786	0.759	0.778	0.814	0.763	0.787	0.781	0.008	0.760	0.802	2.7%	0.747
6/22	0.811	0.775	0.791	0.835	0.798	0.812	0.804	0.008	0.782	0.825	2.7%	0.787
6/23	0.839	0.798	0.809	0.849	0.836	0.834	0.828	0.008	0.807	0.848	2.5%	0.823
6/24	0.857	0.818	0.833	0.869	0.873	0.864	0.852	0.009	0.829	0.876	2.7%	0.846
6/25	0.872	0.852	0.859	0.889	0.902	0.889	0.877	0.008	0.857	0.897	2.3%	0.867
6/26	0.887	0.881	0.898	0.913	0.931	0.919	0.905	0.008	0.884	0.925	2.2%	0.891
6/27	0.899	0.921	0.925	0.932	0.949	0.940	0.928	0.007	0.910	0.946	2.0%	0.922
6/28	0.924	0.963	0.952	0.963	0.966	0.962	0.955	0.007	0.938	0.972	1.8%	0.952
6/29	0.962	0.983	0.973	0.978	0.980	0.982	0.976	0.003	0.968	0.985	0.8%	0.975
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%	1.000

[a] Relative precision.

Appendix A2. Historical daily cumulative proportions of the effort by unguided anglers during the return of early-run chinook salmon to the Kenai River, 1986-1991.

	Daily cumulative proportions [P(t)] by year of unguided angler effort								95% Confidence Interval		
Date	1986	1987	1988	1989	1990	1991	Mean	SE	Low	High	Rel Pre [a]
5/16	0.000	0.005	0.000	0.003	0.006	0.006	0.003	0.001	0.000	0.006	86.6%
5/17	0.005	0.011	0.005	0.006	0.011	0.011	0.008	0.001	0.005	0.012	42.2%
5/18	0.010	0.011	0.009	0.010	0.018	0.017	0.013	0.002	0.009	0.017	31.6%
5/19	0.010	0.016	0.014	0.015	0.052	0.022	0.021	0.006	0.005	0.037	75.4%
5/20	0.015	0.019	0.027	0.034	0.075	0.022	0.032	0.009	0.009	0.055	71.7%
5/21	0.020	0.024	0.064	0.041	0.075	0.028	0.042	0.009	0.018	0.065	56.3%
5/22	0.023	0.029	0.089	0.041	0.087	0.034	0.051	0.012	0.019	0.082	61.9%
5/23	0.027	0.055	0.089	0.048	0.103	0.039	0.060	0.012	0.029	0.091	51.4%
5/24	0.042	0.080	0.100	0.054	0.119	0.061	0.076	0.012	0.045	0.107	40.4%
5/25	0.072	0.087	0.108	0.058	0.141	0.068	0.089	0.013	0.057	0.121	36.4%
5/26	0.083	0.095	0.115	0.067	0.231	0.136	0.121	0.024	0.059	0.183	51.2%
5/27	0.084	0.101	0.130	0.104	0.318	0.149	0.148	0.035	0.057	0.238	61.3%
5/28	0.085	0.109	0.150	0.158	0.371	0.156	0.171	0.042	0.065	0.278	62.4%
5/29	0.089	0.118	0.207	0.175	0.388	0.166	0.190	0.043	0.079	0.301	58.3%
5/30	0.094	0.180	0.222	0.183	0.413	0.178	0.212	0.044	0.099	0.324	53.1%
5/31	0.110	0.218	0.247	0.192	0.432	0.192	0.232	0.044	0.118	0.345	48.9%
6/01	0.121	0.218	0.267	0.200	0.453	0.246	0.251	0.045	0.134	0.368	46.5%
6/02	0.121	0.238	0.304	0.209	0.506	0.297	0.279	0.053	0.143	0.415	48.7%
6/03	0.129	0.259	0.329	0.276	0.584	0.297	0.312	0.061	0.155	0.470	50.3%
6/04	0.140	0.279	0.416	0.309	0.584	0.324	0.342	0.061	0.186	0.498	45.6%
6/05	0.157	0.310	0.433	0.309	0.617	0.401	0.371	0.063	0.210	0.533	43.5%
6/06	0.177	0.396	0.433	0.332	0.655	0.404	0.400	0.063	0.237	0.562	40.8%
6/07	0.267	0.438	0.466	0.360	0.656	0.416	0.434	0.053	0.298	0.570	31.3%
6/08	0.325	0.438	0.486	0.387	0.664	0.437	0.456	0.047	0.335	0.577	26.6%
6/09	0.325	0.474	0.496	0.421	0.686	0.452	0.475	0.049	0.350	0.600	26.3%
6/10	0.358	0.502	0.509	0.471	0.694	0.452	0.498	0.045	0.382	0.614	23.3%
6/11	0.386	0.530	0.569	0.510	0.694	0.465	0.526	0.042	0.417	0.635	20.7%
6/12	0.415	0.564	0.593	0.510	0.703	0.485	0.545	0.041	0.441	0.649	19.2%
6/13	0.487	0.630	0.593	0.537	0.705	0.495	0.575	0.035	0.485	0.664	15.5%
6/14	0.566	0.658	0.625	0.551	0.714	0.510	0.604	0.031	0.525	0.683	13.1%
6/15	0.640	0.658	0.648	0.575	0.727	0.524	0.629	0.029	0.555	0.703	11.8%
6/16	0.640	0.674	0.678	0.598	0.746	0.553	0.648	0.028	0.577	0.719	10.9%
6/17	0.677	0.702	0.707	0.642	0.766	0.553	0.674	0.029	0.599	0.750	11.2%
6/18	0.699	0.726	0.741	0.668	0.766	0.569	0.695	0.029	0.621	0.769	10.6%
6/19	0.720	0.749	0.763	0.668	0.785	0.577	0.711	0.031	0.630	0.791	11.3%
6/20	0.746	0.798	0.763	0.694	0.800	0.602	0.734	0.031	0.655	0.813	10.8%
6/21	0.791	0.834	0.790	0.726	0.813	0.617	0.762	0.033	0.678	0.845	11.0%
6/22	0.815	0.834	0.812	0.750	0.829	0.675	0.786	0.025	0.720	0.851	8.3%
6/23	0.815	0.847	0.832	0.779	0.869	0.697	0.806	0.025	0.742	0.871	8.0%
6/24	0.833	0.864	0.849	0.827	0.907	0.697	0.829	0.029	0.755	0.904	9.0%
6/25	0.858	0.888	0.898	0.883	0.907	0.707	0.857	0.031	0.778	0.936	9.2%
6/26	0.888	0.920	0.931	0.883	0.925	0.722	0.878	0.032	0.795	0.961	9.4%
6/27	0.913	0.943	0.931	0.923	0.943	0.736	0.898	0.033	0.814	0.982	9.4%
6/28	0.960	0.980	0.959	0.953	0.956	0.811	0.937	0.025	0.871	1.002	7.0%
6/29	1.000	0.980	0.984	0.980	0.972	0.918	0.972	0.012	0.943	1.002	3.0%
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision

Appendix A3. Historical daily cumulative proportions of the HPUE (harvest per hour) for chinook salmon by unguided anglers during the return of early-run chinook salmon to the Kenai River, 1986-1991.

	Daily cumulative proportions [P(t)] by year of unguided angler HPUE								95% Confidence Interval		
Date	1986	1987	1988	1989	1990	1991	Mean	SE	Low	High	Rel Pre [a]
5/16	0.000	0.135	0.000	0.122	0.000	0.000	0.043	0.027	0.000	0.113	162.9%
5/17	0.000	0.135	0.000	0.224	0.000	0.000	0.060	0.040	0.000	0.162	169.9%
5/18	0.006	0.135	0.011	0.224	0.000	0.000	0.063	0.039	0.000	0.162	159.0%
5/19	0.006	0.145	0.098	0.224	0.000	0.000	0.079	0.038	0.000	0.177	124.4%
5/20	0.006	0.169	0.183	0.224	0.000	0.000	0.097	0.043	0.000	0.208	114.4%
5/21	0.006	0.186	0.212	0.253	0.000	0.000	0.109	0.049	0.000	0.235	114.8%
5/22	0.047	0.186	0.223	0.253	0.000	0.000	0.118	0.047	0.000	0.239	102.7%
5/23	0.051	0.197	0.223	0.277	0.000	0.000	0.125	0.050	0.000	0.253	102.9%
5/24	0.061	0.206	0.252	0.295	0.036	0.000	0.142	0.051	0.011	0.272	92.3%
5/25	0.072	0.212	0.252	0.295	0.036	0.076	0.157	0.045	0.043	0.272	72.8%
5/26	0.072	0.217	0.271	0.320	0.036	0.117	0.173	0.047	0.053	0.293	69.5%
5/27	0.072	0.217	0.285	0.320	0.109	0.117	0.187	0.042	0.080	0.294	57.4%
5/28	0.130	0.217	0.308	0.343	0.109	0.362	0.245	0.045	0.130	0.360	46.8%
5/29	0.130	0.259	0.320	0.353	0.219	0.543	0.304	0.058	0.156	0.452	48.7%
5/30	0.142	0.283	0.335	0.353	0.219	0.543	0.312	0.056	0.169	0.456	46.1%
5/31	0.145	0.313	0.353	0.353	0.219	0.543	0.321	0.056	0.178	0.464	44.6%
6/01	0.159	0.313	0.441	0.365	0.842	0.597	0.453	0.098	0.202	0.704	55.4%
6/02	0.159	0.388	0.464	0.383	0.931	0.621	0.491	0.107	0.216	0.766	56.1%
6/03	0.159	0.416	0.477	0.419	0.976	0.621	0.511	0.111	0.225	0.797	55.9%
6/04	0.159	0.453	0.490	0.433	0.976	0.804	0.552	0.119	0.246	0.859	55.4%
6/05	0.204	0.481	0.508	0.433	1.000	0.868	0.582	0.121	0.272	0.893	53.3%
6/06	0.246	0.492	0.508	0.442	1.000	0.868	0.593	0.116	0.295	0.890	50.2%
6/07	0.288	0.509	0.511	0.658	1.000	0.868	0.639	0.106	0.365	0.913	42.8%
6/08	0.326	0.509	0.536	0.673	1.000	0.868	0.652	0.101	0.391	0.913	40.0%
6/09	0.326	0.522	0.567	0.684	1.000	0.868	0.661	0.100	0.405	0.918	38.8%
6/10	0.371	0.550	0.590	0.702	1.000	0.868	0.680	0.093	0.442	0.919	35.1%
6/11	0.417	0.652	0.602	0.722	1.000	0.868	0.710	0.084	0.495	0.925	30.3%
6/12	0.468	0.662	0.617	0.722	1.000	0.868	0.723	0.077	0.525	0.921	27.4%
6/13	0.510	0.671	0.617	0.722	1.000	0.868	0.731	0.072	0.546	0.917	25.4%
6/14	0.535	0.695	0.643	0.722	1.000	0.868	0.744	0.068	0.569	0.918	23.4%
6/15	0.576	0.695	0.681	0.722	1.000	0.868	0.757	0.062	0.598	0.916	21.0%
6/16	0.576	0.743	0.705	0.722	1.000	0.868	0.769	0.060	0.615	0.923	20.0%
6/17	0.587	0.763	0.749	0.728	1.000	0.868	0.782	0.057	0.636	0.929	18.7%
6/18	0.594	0.781	0.761	0.763	1.000	0.868	0.795	0.055	0.654	0.935	17.7%
6/19	0.642	0.869	0.791	0.763	1.000	0.868	0.822	0.049	0.695	0.949	15.4%
6/20	0.694	0.887	0.791	0.818	1.000	0.868	0.843	0.042	0.735	0.951	12.8%
6/21	0.709	0.916	0.815	0.841	1.000	0.868	0.858	0.040	0.756	0.961	12.0%
6/22	0.746	0.916	0.832	0.858	1.000	0.868	0.870	0.035	0.781	0.959	10.2%
6/23	0.746	0.924	0.845	0.927	1.000	0.868	0.885	0.035	0.794	0.976	10.3%
6/24	0.804	0.941	0.877	0.951	1.000	0.868	0.907	0.029	0.833	0.981	8.2%
6/25	0.846	0.958	0.890	0.961	1.000	0.868	0.921	0.025	0.857	0.985	7.0%
6/26	0.878	0.972	0.905	0.961	1.000	0.868	0.931	0.022	0.874	0.988	6.1%
6/27	0.965	0.986	0.905	0.987	1.000	0.868	0.952	0.022	0.896	1.008	5.9%
6/28	0.993	1.000	0.953	1.000	1.000	0.932	0.980	0.012	0.948	1.011	3.2%
6/29	1.000	1.000	0.977	1.000	1.000	0.976	0.992	0.005	0.979	1.005	1.3%
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision

Appendix A4. Historical daily cumulative proportions of the CPUE (catch per hour) for chinook salmon by unguided anglers during the return of early-run chinook salmon to the Kenai River, 1986-1991.

	Daily cumulative proportions [P(t)] by year of unguided angler CPUE								95% Confidence Interval		
Date	1986	1987	1988	1989	1990	1991	Mean	SE	Low	High	Rel Pre [a]
5/16	0.000	0.100	0.000	0.095	0.000	0.000	0.032	0.021	0.000	0.085	162.7%
5/17	0.000	0.104	0.000	0.175	0.000	0.000	0.046	0.031	0.000	0.126	170.4%
5/18	0.007	0.104	0.015	0.175	0.000	0.000	0.050	0.030	0.000	0.127	152.5%
5/19	0.007	0.111	0.074	0.175	0.000	0.000	0.061	0.029	0.000	0.137	123.7%
5/20	0.007	0.181	0.131	0.175	0.000	0.000	0.082	0.036	0.000	0.176	113.7%
5/21	0.007	0.194	0.171	0.198	0.000	0.000	0.095	0.042	0.000	0.202	112.5%
5/22	0.033	0.194	0.179	0.198	0.000	0.000	0.101	0.040	0.000	0.205	103.5%
5/23	0.035	0.206	0.179	0.217	0.000	0.000	0.106	0.043	0.000	0.216	103.8%
5/24	0.048	0.212	0.233	0.231	0.010	0.000	0.122	0.047	0.003	0.242	97.9%
5/25	0.066	0.225	0.233	0.231	0.010	0.015	0.130	0.045	0.013	0.246	89.7%
5/26	0.066	0.248	0.252	0.250	0.010	0.022	0.142	0.049	0.015	0.268	89.4%
5/27	0.066	0.248	0.261	0.250	0.030	0.022	0.147	0.048	0.023	0.271	84.6%
5/28	0.120	0.248	0.280	0.268	0.038	0.069	0.171	0.044	0.058	0.284	66.3%
5/29	0.126	0.310	0.290	0.299	0.069	0.104	0.200	0.045	0.083	0.317	58.5%
5/30	0.134	0.334	0.304	0.299	0.069	0.133	0.212	0.046	0.094	0.331	55.9%
5/31	0.137	0.366	0.316	0.299	0.069	0.133	0.220	0.050	0.092	0.348	58.0%
6/01	0.150	0.366	0.382	0.309	0.242	0.149	0.266	0.042	0.158	0.374	40.5%
6/02	0.150	0.440	0.413	0.323	0.304	0.154	0.297	0.051	0.168	0.427	43.7%
6/03	0.150	0.468	0.427	0.357	0.324	0.154	0.313	0.055	0.172	0.455	45.2%
6/04	0.150	0.512	0.438	0.372	0.324	0.224	0.337	0.055	0.196	0.478	41.8%
6/05	0.188	0.532	0.456	0.372	0.324	0.241	0.352	0.053	0.216	0.488	38.6%
6/06	0.247	0.542	0.456	0.402	0.324	0.261	0.372	0.047	0.250	0.494	32.7%
6/07	0.285	0.556	0.458	0.599	0.324	0.285	0.418	0.057	0.271	0.564	35.1%
6/08	0.320	0.556	0.477	0.634	0.324	0.311	0.437	0.057	0.291	0.583	33.4%
6/09	0.320	0.568	0.508	0.642	0.371	0.340	0.458	0.054	0.318	0.598	30.5%
6/10	0.418	0.601	0.528	0.659	0.398	0.340	0.491	0.051	0.359	0.622	26.8%
6/11	0.466	0.676	0.542	0.674	0.398	0.377	0.522	0.054	0.384	0.660	26.5%
6/12	0.521	0.686	0.554	0.674	0.428	0.451	0.552	0.044	0.438	0.667	20.7%
6/13	0.558	0.695	0.554	0.674	0.443	0.488	0.569	0.041	0.464	0.673	18.4%
6/14	0.585	0.718	0.587	0.674	0.443	0.488	0.582	0.043	0.472	0.693	18.9%
6/15	0.617	0.718	0.622	0.697	0.443	0.511	0.601	0.044	0.489	0.713	18.6%
6/16	0.617	0.723	0.655	0.703	0.443	0.511	0.609	0.045	0.492	0.725	19.1%
6/17	0.624	0.752	0.684	0.713	0.580	0.511	0.644	0.037	0.550	0.738	14.7%
6/18	0.630	0.769	0.709	0.750	0.580	0.557	0.666	0.037	0.572	0.760	14.1%
6/19	0.659	0.850	0.742	0.750	0.648	0.651	0.717	0.033	0.633	0.801	11.7%
6/20	0.692	0.874	0.742	0.822	0.676	0.809	0.769	0.032	0.687	0.852	10.7%
6/21	0.707	0.900	0.765	0.847	0.820	0.809	0.808	0.027	0.738	0.878	8.7%
6/22	0.732	0.900	0.777	0.873	0.820	0.956	0.843	0.034	0.756	0.930	10.3%
6/23	0.732	0.906	0.789	0.934	0.820	0.968	0.858	0.038	0.762	0.955	11.2%
6/24	0.776	0.918	0.852	0.961	0.873	0.968	0.892	0.030	0.815	0.968	8.6%
6/25	0.822	0.939	0.866	0.970	0.873	0.968	0.906	0.025	0.842	0.971	7.1%
6/26	0.843	0.965	0.883	0.970	0.940	0.968	0.928	0.022	0.873	0.984	6.0%
6/27	0.941	0.985	0.883	0.990	0.966	0.968	0.956	0.016	0.914	0.997	4.3%
6/28	0.983	1.000	0.940	1.000	0.966	0.980	0.978	0.009	0.955	1.002	2.4%
6/29	1.000	1.000	0.957	1.000	1.000	0.991	0.991	0.007	0.973	1.009	1.8%
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision

Appendix A5. Historical daily cumulative proportions of the harvest of chinook salmon by unguided anglers during the return of early-run chinook salmon to the Kenai River, 1986-1991.

	Daily cumulative proportions [P(t)] by year of unguided angler harvest								95% Confidence Interval		
Date	1986	1987	1988	1989	1990	1991	Mean	SE	Low	High	Rel Pre [a]
5/16	0.000	0.030	0.000	0.016	0.000	0.000	0.008	0.005	0.000	0.021	172.8%
5/17	0.000	0.030	0.000	0.030	0.000	0.000	0.010	0.006	0.000	0.026	162.6%
5/18	0.001	0.030	0.002	0.030	0.000	0.000	0.010	0.006	0.000	0.026	150.4%
5/19	0.001	0.031	0.020	0.030	0.000	0.000	0.014	0.006	0.000	0.030	116.1%
5/20	0.001	0.035	0.070	0.030	0.000	0.000	0.023	0.011	0.000	0.052	130.5%
5/21	0.001	0.038	0.119	0.038	0.000	0.000	0.033	0.019	0.000	0.081	147.8%
5/22	0.005	0.038	0.132	0.038	0.000	0.000	0.036	0.021	0.000	0.089	149.3%
5/23	0.005	0.052	0.132	0.045	0.000	0.000	0.039	0.021	0.000	0.092	137.3%
5/24	0.010	0.060	0.146	0.050	0.020	0.000	0.048	0.022	0.000	0.104	118.2%
5/25	0.021	0.062	0.146	0.050	0.020	0.019	0.053	0.020	0.001	0.105	97.6%
5/26	0.021	0.064	0.152	0.059	0.020	0.105	0.070	0.021	0.016	0.124	76.6%
5/27	0.021	0.064	0.162	0.059	0.222	0.105	0.106	0.030	0.027	0.184	74.2%
5/28	0.022	0.064	0.183	0.111	0.222	0.159	0.127	0.031	0.048	0.206	62.4%
5/29	0.022	0.080	0.213	0.118	0.284	0.214	0.155	0.040	0.052	0.258	66.4%
5/30	0.024	0.144	0.223	0.118	0.284	0.214	0.168	0.038	0.071	0.264	57.6%
5/31	0.026	0.193	0.244	0.118	0.284	0.214	0.180	0.038	0.081	0.278	54.7%
6/01	0.031	0.193	0.324	0.122	0.716	0.303	0.281	0.098	0.030	0.533	89.4%
6/02	0.031	0.256	0.362	0.129	0.863	0.341	0.330	0.118	0.026	0.635	92.2%
6/03	0.031	0.281	0.376	0.232	0.974	0.341	0.372	0.130	0.038	0.707	89.8%
6/04	0.031	0.312	0.428	0.250	0.974	0.495	0.415	0.130	0.081	0.748	80.4%
6/05	0.055	0.349	0.442	0.250	1.000	0.646	0.457	0.135	0.110	0.804	75.9%
6/06	0.080	0.390	0.442	0.260	1.000	0.646	0.470	0.131	0.133	0.807	71.7%
6/07	0.196	0.420	0.446	0.517	1.000	0.646	0.538	0.110	0.254	0.821	52.7%
6/08	0.266	0.420	0.468	0.535	1.000	0.646	0.556	0.103	0.292	0.820	47.5%
6/09	0.266	0.440	0.482	0.551	1.000	0.646	0.564	0.101	0.304	0.825	46.2%
6/10	0.312	0.475	0.496	0.590	1.000	0.646	0.586	0.095	0.342	0.831	41.6%
6/11	0.351	0.596	0.528	0.621	1.000	0.646	0.624	0.087	0.400	0.847	35.8%
6/12	0.397	0.610	0.544	0.621	1.000	0.646	0.637	0.081	0.427	0.846	32.9%
6/13	0.491	0.638	0.544	0.621	1.000	0.646	0.657	0.073	0.469	0.844	28.6%
6/14	0.552	0.665	0.581	0.621	1.000	0.646	0.678	0.067	0.506	0.849	25.3%
6/15	0.648	0.665	0.621	0.621	1.000	0.646	0.700	0.060	0.545	0.855	22.2%
6/16	0.648	0.699	0.655	0.621	1.000	0.646	0.711	0.059	0.561	0.862	21.2%
6/17	0.660	0.722	0.712	0.632	1.000	0.646	0.729	0.056	0.584	0.873	19.8%
6/18	0.665	0.742	0.731	0.672	1.000	0.646	0.742	0.054	0.604	0.881	18.6%
6/19	0.696	0.828	0.761	0.672	1.000	0.646	0.767	0.054	0.629	0.905	18.0%
6/20	0.739	0.867	0.761	0.733	1.000	0.646	0.791	0.051	0.660	0.922	16.5%
6/21	0.760	0.911	0.789	0.764	1.000	0.646	0.812	0.051	0.680	0.943	16.2%
6/22	0.787	0.911	0.806	0.781	1.000	0.646	0.822	0.050	0.694	0.949	15.5%
6/23	0.787	0.915	0.818	0.866	1.000	0.646	0.839	0.049	0.712	0.965	15.1%
6/24	0.819	0.927	0.843	0.915	1.000	0.646	0.858	0.050	0.730	0.987	15.0%
6/25	0.853	0.946	0.872	0.941	1.000	0.646	0.876	0.051	0.745	1.007	14.9%
6/26	0.883	0.964	0.895	0.941	1.000	0.646	0.888	0.052	0.756	1.021	14.9%
6/27	0.951	0.978	0.895	0.983	1.000	0.646	0.909	0.055	0.768	1.049	15.5%
6/28	0.991	1.000	0.957	1.000	1.000	0.792	0.957	0.034	0.870	1.043	9.0%
6/29	1.000	1.000	0.983	1.000	1.000	0.938	0.987	0.010	0.961	1.013	2.7%
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision

Appendix A6. Historical daily cumulative proportions of the catch of chinook salmon by unguided anglers during the return of early-run chinook salmon to the Kenai River, 1986-1991.

	Daily cumulative proportions [P(t)] by year of unguided angler catch								95% Confidence Interval		
Date	1986	1987	1988	1989	1990	1991	Mean	SE	Low	High	Rel Pre [a]
5/16	0.000	0.023	0.000	0.012	0.000	0.000	0.006	0.004	0.000	0.016	173.9%
5/17	0.000	0.024	0.000	0.022	0.000	0.000	0.008	0.005	0.000	0.020	162.8%
5/18	0.001	0.024	0.003	0.022	0.000	0.000	0.008	0.005	0.000	0.021	143.6%
5/19	0.001	0.025	0.015	0.022	0.000	0.000	0.011	0.005	0.000	0.023	116.2%
5/20	0.001	0.036	0.048	0.022	0.000	0.000	0.018	0.008	0.000	0.040	121.9%
5/21	0.001	0.039	0.111	0.029	0.000	0.000	0.030	0.018	0.000	0.075	150.8%
5/22	0.003	0.039	0.121	0.029	0.000	0.000	0.032	0.019	0.000	0.081	152.6%
5/23	0.004	0.053	0.121	0.034	0.000	0.000	0.035	0.019	0.000	0.085	140.4%
5/24	0.010	0.060	0.147	0.038	0.007	0.000	0.044	0.023	0.000	0.102	133.4%
5/25	0.026	0.064	0.147	0.038	0.007	0.004	0.048	0.022	0.000	0.104	117.2%
5/26	0.026	0.072	0.152	0.045	0.007	0.024	0.054	0.022	0.000	0.110	101.9%
5/27	0.026	0.072	0.159	0.045	0.082	0.024	0.068	0.021	0.015	0.121	77.7%
5/28	0.027	0.072	0.175	0.084	0.100	0.037	0.082	0.022	0.027	0.138	67.6%
5/29	0.028	0.098	0.200	0.105	0.122	0.049	0.100	0.025	0.037	0.164	63.3%
5/30	0.029	0.165	0.209	0.105	0.122	0.062	0.116	0.027	0.047	0.185	59.7%
5/31	0.031	0.220	0.223	0.105	0.122	0.062	0.127	0.033	0.044	0.211	65.7%
6/01	0.035	0.220	0.280	0.108	0.281	0.094	0.170	0.043	0.060	0.280	64.7%
6/02	0.035	0.246	0.331	0.114	0.420	0.103	0.208	0.061	0.051	0.365	75.3%
6/03	0.035	0.288	0.346	0.207	0.484	0.103	0.244	0.067	0.071	0.416	70.7%
6/04	0.035	0.306	0.390	0.227	0.484	0.174	0.269	0.065	0.102	0.437	62.3%
6/05	0.055	0.335	0.403	0.227	0.484	0.222	0.288	0.062	0.128	0.448	55.6%
6/06	0.090	0.373	0.403	0.256	0.484	0.225	0.305	0.058	0.156	0.454	49.0%
6/07	0.194	0.398	0.406	0.481	0.484	0.234	0.366	0.051	0.236	0.496	35.5%
6/08	0.257	0.398	0.422	0.519	0.484	0.255	0.389	0.046	0.272	0.507	30.1%
6/09	0.257	0.418	0.436	0.531	0.528	0.272	0.407	0.049	0.281	0.533	30.9%
6/10	0.357	0.460	0.447	0.566	0.538	0.272	0.440	0.045	0.324	0.556	26.4%
6/11	0.398	0.554	0.485	0.590	0.538	0.289	0.476	0.046	0.357	0.594	25.0%
6/12	0.446	0.570	0.497	0.590	0.549	0.343	0.499	0.038	0.402	0.596	19.5%
6/13	0.530	0.597	0.497	0.590	0.550	0.357	0.520	0.036	0.428	0.613	17.8%
6/14	0.594	0.626	0.544	0.590	0.550	0.357	0.543	0.039	0.442	0.644	18.6%
6/15	0.668	0.626	0.579	0.612	0.550	0.368	0.567	0.043	0.456	0.678	19.5%
6/16	0.668	0.647	0.622	0.618	0.550	0.368	0.579	0.045	0.463	0.695	20.1%
6/17	0.676	0.683	0.660	0.635	0.667	0.368	0.615	0.050	0.487	0.743	20.8%
6/18	0.680	0.702	0.696	0.676	0.667	0.396	0.636	0.048	0.512	0.761	19.6%
6/19	0.699	0.786	0.729	0.676	0.724	0.427	0.673	0.052	0.541	0.806	19.7%
6/20	0.725	0.839	0.729	0.752	0.742	0.572	0.727	0.035	0.635	0.818	12.5%
6/21	0.746	0.881	0.756	0.785	0.821	0.572	0.760	0.043	0.650	0.870	14.5%
6/22	0.764	0.881	0.767	0.810	0.821	0.885	0.821	0.022	0.766	0.877	6.8%
6/23	0.764	0.885	0.778	0.883	0.821	0.895	0.838	0.024	0.777	0.898	7.3%
6/24	0.789	0.894	0.827	0.936	0.905	0.895	0.874	0.022	0.817	0.932	6.6%
6/25	0.824	0.917	0.856	0.955	0.905	0.895	0.892	0.019	0.843	0.941	5.5%
6/26	0.844	0.955	0.880	0.955	0.958	0.895	0.915	0.020	0.864	0.965	5.6%
6/27	0.920	0.976	0.880	0.987	0.977	0.895	0.939	0.019	0.890	0.988	5.2%
6/28	0.980	1.000	0.952	1.000	0.977	0.928	0.973	0.011	0.943	1.002	3.0%
6/29	1.000	1.000	0.969	1.000	1.000	0.973	0.990	0.006	0.975	1.006	1.6%
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision

Appendix A7. Historical daily cumulative proportions of the effort by guided anglers during the return of early-run chinook salmon to the Kenai River, 1986-1991.

	Daily cumulative proportions [P(t)] by year of guided angler effort								95% Confidence Interval		
Date	1986	1987	1988	1989	1990	1991	Mean	SE	Low	High	Rel Pre [a]
5/16	0.000	0.000	0.000	0.005	0.006	0.009	0.003	0.002	0.000	0.008	121.5%
5/17	0.000	0.011	0.008	0.009	0.018	0.028	0.012	0.004	0.002	0.022	80.5%
5/18	0.000	0.011	0.017	0.016	0.036	0.037	0.019	0.006	0.004	0.034	77.5%
5/19	0.000	0.019	0.026	0.023	0.065	0.046	0.030	0.009	0.006	0.054	80.0%
5/20	0.000	0.026	0.033	0.047	0.084	0.046	0.039	0.011	0.010	0.069	74.2%
5/21	0.000	0.032	0.066	0.056	0.084	0.055	0.049	0.012	0.018	0.079	62.9%
5/22	0.031	0.038	0.092	0.056	0.110	0.064	0.065	0.013	0.033	0.097	49.2%
5/23	0.043	0.064	0.092	0.063	0.131	0.074	0.078	0.012	0.046	0.110	40.9%
5/24	0.054	0.080	0.113	0.070	0.148	0.083	0.091	0.014	0.056	0.127	38.9%
5/25	0.067	0.089	0.127	0.077	0.172	0.092	0.104	0.016	0.063	0.145	39.2%
5/26	0.081	0.105	0.137	0.104	0.223	0.124	0.129	0.020	0.077	0.181	40.3%
5/27	0.095	0.118	0.158	0.123	0.265	0.160	0.153	0.025	0.090	0.216	41.2%
5/28	0.109	0.120	0.165	0.147	0.300	0.160	0.167	0.028	0.094	0.239	43.5%
5/29	0.118	0.130	0.192	0.158	0.316	0.202	0.186	0.029	0.111	0.261	40.4%
5/30	0.129	0.194	0.202	0.178	0.346	0.245	0.216	0.030	0.138	0.293	36.1%
5/31	0.163	0.231	0.223	0.200	0.364	0.251	0.238	0.028	0.167	0.310	30.1%
6/01	0.175	0.231	0.240	0.220	0.392	0.292	0.258	0.031	0.179	0.337	30.7%
6/02	0.175	0.246	0.271	0.243	0.398	0.318	0.275	0.031	0.195	0.355	29.0%
6/03	0.187	0.275	0.295	0.264	0.434	0.318	0.296	0.033	0.210	0.381	28.8%
6/04	0.199	0.293	0.337	0.291	0.434	0.378	0.322	0.033	0.237	0.407	26.4%
6/05	0.220	0.321	0.366	0.291	0.458	0.431	0.348	0.036	0.254	0.441	26.9%
6/06	0.267	0.349	0.366	0.333	0.518	0.440	0.379	0.036	0.286	0.471	24.4%
6/07	0.347	0.368	0.398	0.366	0.524	0.443	0.407	0.027	0.338	0.477	17.0%
6/08	0.379	0.368	0.432	0.400	0.532	0.455	0.428	0.025	0.364	0.491	14.9%
6/09	0.379	0.420	0.467	0.434	0.538	0.463	0.450	0.022	0.394	0.507	12.5%
6/10	0.426	0.458	0.500	0.474	0.553	0.463	0.479	0.018	0.433	0.525	9.5%
6/11	0.460	0.494	0.537	0.503	0.553	0.471	0.503	0.015	0.465	0.541	7.6%
6/12	0.478	0.529	0.548	0.503	0.572	0.501	0.522	0.014	0.486	0.558	6.9%
6/13	0.536	0.562	0.548	0.534	0.591	0.520	0.549	0.010	0.522	0.575	4.8%
6/14	0.577	0.594	0.585	0.554	0.611	0.559	0.580	0.009	0.558	0.603	3.9%
6/15	0.610	0.594	0.614	0.587	0.637	0.575	0.603	0.009	0.579	0.626	3.9%
6/16	0.610	0.623	0.654	0.618	0.653	0.606	0.627	0.009	0.605	0.649	3.5%
6/17	0.652	0.671	0.675	0.649	0.672	0.606	0.654	0.011	0.627	0.681	4.2%
6/18	0.688	0.703	0.711	0.674	0.672	0.624	0.679	0.013	0.646	0.711	4.8%
6/19	0.728	0.740	0.739	0.674	0.713	0.663	0.710	0.014	0.675	0.745	4.9%
6/20	0.767	0.775	0.739	0.700	0.744	0.683	0.735	0.015	0.697	0.773	5.2%
6/21	0.798	0.804	0.772	0.739	0.771	0.701	0.764	0.016	0.724	0.805	5.3%
6/22	0.813	0.804	0.808	0.779	0.799	0.723	0.788	0.014	0.752	0.823	4.5%
6/23	0.813	0.841	0.826	0.809	0.829	0.743	0.810	0.014	0.774	0.846	4.5%
6/24	0.835	0.866	0.858	0.842	0.850	0.743	0.832	0.018	0.785	0.880	5.7%
6/25	0.874	0.900	0.888	0.874	0.850	0.758	0.857	0.021	0.803	0.911	6.3%
6/26	0.902	0.922	0.912	0.874	0.891	0.771	0.879	0.023	0.820	0.937	6.6%
6/27	0.932	0.957	0.912	0.914	0.922	0.786	0.904	0.025	0.841	0.967	7.0%
6/28	0.976	0.983	0.941	0.947	0.947	0.869	0.944	0.017	0.901	0.987	4.5%
6/29	1.000	0.983	0.971	0.974	0.969	0.950	0.975	0.007	0.957	0.992	1.8%
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision

Appendix A8. Historical daily cumulative proportions of the HPUE (harvest per hour) for chinook salmon by guided anglers during the return of early-run chinook salmon to the Kenai River, 1986-1991.

	Daily cumulative proportions [P(t)] by year of guided angler HPUE								95% Confidence Interval		
Date	1986	1987	1988	1989	1990	1991	Mean	SE	Low	High	Rel Pre [a]
5/16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
5/17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
5/18	0.000	0.000	0.022	0.024	0.000	0.000	0.008	0.005	0.000	0.020	162.7%
5/19	0.000	0.000	0.045	0.063	0.000	0.000	0.018	0.012	0.000	0.048	165.9%
5/20	0.042	0.000	0.075	0.070	0.033	0.000	0.037	0.013	0.003	0.071	93.1%
5/21	0.042	0.014	0.075	0.084	0.033	0.000	0.041	0.013	0.007	0.076	83.6%
5/22	0.051	0.014	0.115	0.084	0.071	0.000	0.056	0.018	0.010	0.101	81.5%
5/23	0.063	0.024	0.115	0.103	0.111	0.000	0.069	0.020	0.018	0.120	73.6%
5/24	0.078	0.041	0.148	0.130	0.130	0.000	0.088	0.024	0.026	0.149	69.9%
5/25	0.093	0.061	0.191	0.130	0.223	0.000	0.116	0.034	0.029	0.203	74.8%
5/26	0.099	0.092	0.216	0.130	0.242	0.019	0.133	0.034	0.046	0.220	65.7%
5/27	0.145	0.092	0.255	0.130	0.265	0.065	0.159	0.034	0.071	0.246	55.2%
5/28	0.157	0.121	0.294	0.142	0.265	0.164	0.191	0.029	0.116	0.265	39.0%
5/29	0.188	0.157	0.312	0.150	0.350	0.231	0.231	0.034	0.144	0.319	37.8%
5/30	0.214	0.185	0.312	0.170	0.542	0.265	0.281	0.056	0.136	0.426	51.5%
5/31	0.226	0.226	0.312	0.215	0.679	0.265	0.321	0.073	0.133	0.508	58.6%
6/01	0.316	0.226	0.384	0.287	0.759	0.297	0.378	0.079	0.175	0.581	53.7%
6/02	0.316	0.276	0.412	0.383	0.853	0.761	0.500	0.100	0.244	0.757	51.2%
6/03	0.316	0.362	0.430	0.435	0.925	0.761	0.538	0.100	0.280	0.796	47.9%
6/04	0.316	0.414	0.453	0.462	0.925	0.821	0.565	0.100	0.307	0.824	45.7%
6/05	0.382	0.488	0.477	0.462	0.974	0.873	0.609	0.101	0.349	0.870	42.7%
6/06	0.412	0.514	0.477	0.486	1.000	0.873	0.627	0.100	0.370	0.884	41.1%
6/07	0.438	0.551	0.484	0.532	1.000	0.873	0.646	0.095	0.403	0.889	37.6%
6/08	0.476	0.551	0.497	0.574	1.000	0.873	0.662	0.090	0.432	0.892	34.8%
6/09	0.476	0.570	0.518	0.633	1.000	0.873	0.678	0.086	0.457	0.899	32.6%
6/10	0.504	0.606	0.539	0.644	1.000	0.873	0.694	0.081	0.487	0.902	29.9%
6/11	0.553	0.639	0.559	0.663	1.000	0.873	0.714	0.074	0.524	0.905	26.7%
6/12	0.578	0.649	0.588	0.663	1.000	0.873	0.725	0.070	0.545	0.905	24.9%
6/13	0.607	0.669	0.588	0.683	1.000	0.873	0.736	0.067	0.564	0.909	23.4%
6/14	0.631	0.697	0.629	0.719	1.000	0.873	0.758	0.061	0.602	0.914	20.5%
6/15	0.661	0.697	0.663	0.737	1.000	0.873	0.772	0.056	0.628	0.915	18.6%
6/16	0.661	0.739	0.693	0.754	1.000	0.873	0.787	0.052	0.653	0.920	17.0%
6/17	0.677	0.785	0.728	0.759	1.000	0.873	0.804	0.047	0.682	0.926	15.2%
6/18	0.690	0.808	0.752	0.776	1.000	0.873	0.816	0.044	0.703	0.930	13.9%
6/19	0.718	0.836	0.785	0.776	1.000	0.873	0.831	0.040	0.728	0.934	12.4%
6/20	0.754	0.855	0.785	0.818	1.000	0.873	0.847	0.035	0.756	0.938	10.7%
6/21	0.768	0.860	0.818	0.856	1.000	0.873	0.863	0.032	0.781	0.944	9.4%
6/22	0.822	0.860	0.837	0.861	1.000	0.873	0.876	0.026	0.809	0.942	7.6%
6/23	0.822	0.867	0.862	0.876	1.000	0.873	0.883	0.025	0.820	0.947	7.2%
6/24	0.844	0.881	0.875	0.896	1.000	0.873	0.895	0.022	0.838	0.952	6.4%
6/25	0.872	0.910	0.888	0.933	1.000	0.873	0.912	0.020	0.861	0.964	5.6%
6/26	0.899	0.952	0.903	0.933	1.000	0.873	0.927	0.019	0.879	0.974	5.1%
6/27	0.935	0.969	0.903	0.981	1.000	0.873	0.943	0.020	0.892	0.995	5.5%
6/28	0.980	0.997	0.944	0.991	1.000	0.894	0.968	0.017	0.924	1.011	4.5%
6/29	1.000	0.997	0.977	1.000	1.000	0.929	0.984	0.012	0.954	1.014	3.0%
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision

Appendix A9. Historical daily cumulative proportions of the CPUE (catch per hour) for chinook salmon by guided anglers during the return of early-run chinook salmon to the Kenai River, 1986-1991.

	Daily cumulative proportions [P(t)] by year of guided angler CPUE								95% Confidence Interval		
Date	1986	1987	1988	1989	1990	1991	Mean	SE	Low	High	Rel Pre [a]
5/16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
5/17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
5/18	0.000	0.000	0.016	0.020	0.000	0.000	0.006	0.004	0.000	0.016	164.2%
5/19	0.000	0.000	0.032	0.052	0.000	0.000	0.014	0.009	0.000	0.037	169.6%
5/20	0.028	0.000	0.052	0.058	0.008	0.000	0.024	0.011	0.000	0.052	112.3%
5/21	0.028	0.016	0.052	0.069	0.008	0.000	0.029	0.011	0.000	0.057	98.4%
5/22	0.037	0.016	0.088	0.069	0.016	0.000	0.038	0.014	0.002	0.074	96.0%
5/23	0.048	0.024	0.088	0.086	0.025	0.000	0.045	0.015	0.008	0.083	82.9%
5/24	0.061	0.037	0.119	0.108	0.030	0.000	0.059	0.019	0.010	0.108	82.7%
5/25	0.075	0.051	0.166	0.108	0.062	0.000	0.077	0.023	0.018	0.136	76.6%
5/26	0.079	0.088	0.192	0.108	0.066	0.010	0.090	0.024	0.028	0.153	69.2%
5/27	0.109	0.088	0.230	0.108	0.071	0.030	0.106	0.027	0.035	0.177	66.6%
5/28	0.126	0.123	0.264	0.118	0.071	0.060	0.127	0.030	0.051	0.203	60.1%
5/29	0.151	0.156	0.280	0.124	0.090	0.079	0.147	0.029	0.071	0.223	51.6%
5/30	0.171	0.180	0.280	0.141	0.134	0.089	0.166	0.026	0.098	0.233	40.8%
5/31	0.185	0.214	0.323	0.178	0.166	0.089	0.193	0.031	0.113	0.273	41.5%
6/01	0.265	0.214	0.386	0.237	0.184	0.097	0.231	0.039	0.130	0.331	43.6%
6/02	0.265	0.278	0.420	0.317	0.226	0.199	0.284	0.032	0.203	0.366	28.8%
6/03	0.265	0.350	0.434	0.367	0.255	0.199	0.312	0.035	0.221	0.403	29.2%
6/04	0.265	0.407	0.461	0.397	0.255	0.219	0.334	0.041	0.230	0.439	31.3%
6/05	0.347	0.467	0.486	0.397	0.273	0.234	0.367	0.042	0.260	0.474	29.1%
6/06	0.382	0.497	0.486	0.420	0.279	0.266	0.388	0.041	0.284	0.493	26.9%
6/07	0.407	0.534	0.493	0.469	0.325	0.313	0.423	0.037	0.328	0.519	22.5%
6/08	0.443	0.534	0.508	0.510	0.358	0.376	0.455	0.030	0.377	0.533	17.2%
6/09	0.443	0.553	0.531	0.586	0.461	0.431	0.501	0.026	0.433	0.569	13.5%
6/10	0.469	0.590	0.553	0.596	0.535	0.431	0.529	0.027	0.459	0.599	13.2%
6/11	0.525	0.622	0.580	0.616	0.535	0.476	0.559	0.023	0.499	0.619	10.7%
6/12	0.557	0.633	0.600	0.616	0.580	0.512	0.583	0.018	0.537	0.629	7.9%
6/13	0.593	0.653	0.600	0.636	0.627	0.542	0.609	0.016	0.567	0.650	6.8%
6/14	0.615	0.679	0.635	0.672	0.674	0.583	0.643	0.016	0.602	0.684	6.4%
6/15	0.641	0.679	0.664	0.692	0.705	0.634	0.669	0.011	0.640	0.699	4.4%
6/16	0.641	0.720	0.695	0.708	0.751	0.694	0.702	0.015	0.664	0.740	5.4%
6/17	0.652	0.769	0.732	0.718	0.779	0.694	0.724	0.019	0.674	0.774	6.9%
6/18	0.667	0.803	0.760	0.745	0.779	0.718	0.745	0.020	0.695	0.796	6.8%
6/19	0.692	0.846	0.793	0.745	0.789	0.738	0.767	0.022	0.711	0.823	7.3%
6/20	0.722	0.867	0.793	0.809	0.833	0.749	0.796	0.022	0.740	0.852	7.0%
6/21	0.736	0.875	0.823	0.846	0.865	0.847	0.832	0.021	0.779	0.885	6.3%
6/22	0.781	0.875	0.841	0.859	0.877	0.907	0.857	0.017	0.812	0.902	5.2%
6/23	0.781	0.882	0.859	0.877	0.894	0.929	0.870	0.020	0.819	0.922	6.0%
6/24	0.809	0.897	0.880	0.901	0.916	0.929	0.889	0.017	0.844	0.934	5.0%
6/25	0.848	0.921	0.893	0.935	0.916	0.939	0.909	0.014	0.873	0.944	3.9%
6/26	0.872	0.957	0.908	0.935	0.944	0.953	0.928	0.013	0.894	0.963	3.7%
6/27	0.939	0.972	0.908	0.982	0.960	0.970	0.955	0.011	0.926	0.984	3.0%
6/28	0.981	0.998	0.946	0.990	0.975	0.975	0.977	0.007	0.959	0.996	1.9%
6/29	1.000	0.998	0.976	1.000	0.988	0.984	0.991	0.004	0.981	1.001	1.0%
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision

Appendix A10. Historical daily cumulative proportions of the harvest of chinook salmon by guided anglers during the return of early-run chinook salmon to the Kenai River, 1986-1991.

	Daily cumulative proportions [P(t)] by year of guided angler harvest								95% Confidence Interval		
Date	1986	1987	1988	1989	1990	1991	Mean	SE	Low	High	Rel Pre [a]
5/16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
5/17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
5/18	0.000	0.000	0.008	0.007	0.000	0.000	0.002	0.001	0.000	0.006	163.1%
5/19	0.000	0.000	0.016	0.018	0.000	0.000	0.006	0.004	0.000	0.015	163.1%
5/20	0.000	0.000	0.025	0.025	0.025	0.000	0.013	0.006	0.000	0.027	115.0%
5/21	0.000	0.003	0.025	0.029	0.025	0.000	0.014	0.006	0.000	0.029	107.1%
5/22	0.009	0.003	0.069	0.029	0.064	0.000	0.029	0.013	0.000	0.061	110.6%
5/23	0.015	0.012	0.069	0.035	0.098	0.000	0.038	0.016	0.000	0.078	104.8%
5/24	0.020	0.022	0.097	0.042	0.112	0.000	0.049	0.018	0.001	0.096	97.1%
5/25	0.027	0.028	0.121	0.042	0.203	0.000	0.070	0.031	0.000	0.151	114.7%
5/26	0.031	0.047	0.131	0.042	0.241	0.017	0.085	0.035	0.000	0.176	107.0%
5/27	0.054	0.047	0.164	0.042	0.280	0.066	0.109	0.039	0.008	0.209	92.2%
5/28	0.060	0.049	0.175	0.054	0.280	0.066	0.114	0.038	0.015	0.213	87.0%
5/29	0.070	0.061	0.195	0.057	0.334	0.145	0.144	0.044	0.030	0.257	79.0%
5/30	0.080	0.125	0.195	0.072	0.571	0.186	0.205	0.076	0.009	0.401	95.5%
5/31	0.095	0.180	0.195	0.110	0.669	0.186	0.239	0.088	0.014	0.465	94.2%
6/01	0.135	0.180	0.246	0.166	0.762	0.224	0.286	0.097	0.037	0.534	87.0%
6/02	0.135	0.206	0.280	0.252	0.782	0.584	0.373	0.103	0.108	0.639	71.1%
6/03	0.135	0.297	0.298	0.294	0.890	0.584	0.416	0.112	0.129	0.704	69.0%
6/04	0.135	0.329	0.338	0.322	0.890	0.685	0.450	0.114	0.156	0.744	65.3%
6/05	0.185	0.403	0.366	0.322	0.936	0.765	0.496	0.118	0.193	0.800	61.2%
6/06	0.235	0.428	0.366	0.362	1.000	0.765	0.526	0.120	0.219	0.833	58.4%
6/07	0.312	0.455	0.374	0.419	1.000	0.765	0.554	0.110	0.272	0.837	51.0%
6/08	0.355	0.455	0.393	0.475	1.000	0.765	0.574	0.104	0.307	0.841	46.5%
6/09	0.355	0.490	0.423	0.551	1.000	0.765	0.597	0.099	0.343	0.852	42.6%
6/10	0.404	0.539	0.450	0.568	1.000	0.765	0.621	0.091	0.386	0.856	37.8%
6/11	0.463	0.580	0.481	0.589	1.000	0.765	0.646	0.083	0.433	0.860	33.1%
6/12	0.480	0.593	0.494	0.589	1.000	0.765	0.654	0.081	0.446	0.861	31.8%
6/13	0.539	0.617	0.494	0.614	1.000	0.765	0.671	0.076	0.477	0.866	29.0%
6/14	0.576	0.648	0.556	0.642	1.000	0.765	0.698	0.067	0.524	0.871	24.9%
6/15	0.612	0.648	0.596	0.665	1.000	0.765	0.714	0.062	0.555	0.874	22.3%
6/16	0.612	0.692	0.644	0.685	1.000	0.765	0.733	0.057	0.585	0.881	20.1%
6/17	0.635	0.770	0.675	0.691	1.000	0.765	0.756	0.053	0.619	0.893	18.1%
6/18	0.653	0.797	0.709	0.707	1.000	0.765	0.772	0.050	0.643	0.900	16.7%
6/19	0.692	0.833	0.747	0.707	1.000	0.765	0.791	0.047	0.671	0.910	15.1%
6/20	0.743	0.857	0.747	0.750	1.000	0.765	0.810	0.042	0.703	0.918	13.3%
6/21	0.758	0.863	0.792	0.807	1.000	0.765	0.831	0.037	0.735	0.926	11.5%
6/22	0.788	0.863	0.818	0.815	1.000	0.765	0.842	0.034	0.753	0.930	10.5%
6/23	0.788	0.872	0.837	0.832	1.000	0.765	0.849	0.034	0.762	0.936	10.3%
6/24	0.805	0.885	0.853	0.858	1.000	0.765	0.861	0.033	0.777	0.945	9.8%
6/25	0.845	0.919	0.869	0.903	1.000	0.765	0.884	0.032	0.801	0.966	9.3%
6/26	0.872	0.951	0.884	0.903	1.000	0.765	0.896	0.032	0.812	0.980	9.3%
6/27	0.911	0.972	0.884	0.979	1.000	0.765	0.918	0.036	0.827	1.010	9.9%
6/28	0.982	0.998	0.934	0.991	1.000	0.817	0.954	0.029	0.879	1.029	7.9%
6/29	1.000	0.998	0.973	1.000	1.000	0.900	0.978	0.016	0.936	1.021	4.3%
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision

Appendix A11. Historical daily cumulative proportions of the catch of chinook salmon by guided anglers during the return of early-run chinook salmon to the Kenai River, 1986-1991.

	Daily cumulative proportions [P(t)] by year of guided angler catch								95% Confidence Interval		
Date	1986	1987	1988	1989	1990	1991	Mean	SE	Low	High	Rel Pre [a]
5/16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
5/17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
5/18	0.000	0.000	0.005	0.005	0.000	0.000	0.002	0.001	0.000	0.005	162.6%
5/19	0.000	0.000	0.011	0.014	0.000	0.000	0.004	0.003	0.000	0.011	164.9%
5/20	0.000	0.000	0.017	0.020	0.007	0.000	0.007	0.004	0.000	0.017	130.2%
5/21	0.000	0.004	0.017	0.024	0.007	0.000	0.009	0.004	0.000	0.019	119.3%
5/22	0.009	0.004	0.055	0.024	0.018	0.000	0.018	0.008	0.000	0.039	116.1%
5/23	0.014	0.011	0.055	0.028	0.027	0.000	0.023	0.008	0.003	0.043	88.7%
5/24	0.018	0.019	0.080	0.034	0.031	0.000	0.030	0.011	0.002	0.059	93.8%
5/25	0.025	0.023	0.105	0.034	0.069	0.000	0.043	0.016	0.003	0.083	93.5%
5/26	0.027	0.045	0.116	0.034	0.079	0.014	0.053	0.016	0.012	0.093	76.3%
5/27	0.042	0.045	0.148	0.034	0.090	0.046	0.067	0.018	0.021	0.114	68.5%
5/28	0.049	0.048	0.157	0.043	0.090	0.046	0.072	0.018	0.025	0.119	65.2%
5/29	0.057	0.060	0.174	0.046	0.105	0.082	0.087	0.019	0.038	0.137	57.1%
5/30	0.065	0.115	0.174	0.058	0.171	0.101	0.114	0.021	0.061	0.167	46.2%
5/31	0.082	0.161	0.209	0.088	0.198	0.101	0.140	0.023	0.080	0.199	42.6%
6/01	0.117	0.161	0.252	0.133	0.224	0.114	0.167	0.024	0.106	0.228	36.7%
6/02	0.117	0.199	0.293	0.202	0.235	0.235	0.213	0.024	0.152	0.275	28.6%
6/03	0.117	0.259	0.307	0.241	0.288	0.235	0.241	0.027	0.171	0.311	29.1%
6/04	0.117	0.297	0.352	0.271	0.288	0.287	0.268	0.032	0.185	0.352	31.0%
6/05	0.175	0.357	0.380	0.271	0.308	0.323	0.302	0.030	0.226	0.379	25.3%
6/06	0.232	0.388	0.380	0.309	0.326	0.335	0.328	0.023	0.269	0.387	18.0%
6/07	0.302	0.413	0.389	0.368	0.339	0.341	0.359	0.016	0.317	0.400	11.6%
6/08	0.342	0.413	0.409	0.421	0.353	0.375	0.386	0.014	0.350	0.421	9.1%
6/09	0.342	0.450	0.442	0.516	0.384	0.395	0.421	0.025	0.358	0.485	15.2%
6/10	0.384	0.501	0.470	0.530	0.439	0.395	0.453	0.024	0.392	0.514	13.4%
6/11	0.450	0.541	0.509	0.553	0.439	0.411	0.484	0.024	0.422	0.545	12.7%
6/12	0.471	0.555	0.518	0.553	0.481	0.458	0.506	0.017	0.462	0.551	8.8%
6/13	0.543	0.579	0.518	0.576	0.524	0.483	0.537	0.015	0.499	0.576	7.2%
6/14	0.574	0.609	0.569	0.603	0.572	0.553	0.580	0.009	0.557	0.603	3.9%
6/15	0.605	0.609	0.603	0.628	0.610	0.589	0.607	0.005	0.594	0.620	2.2%
6/16	0.605	0.661	0.651	0.646	0.648	0.671	0.647	0.009	0.623	0.671	3.7%
6/17	0.620	0.745	0.682	0.657	0.674	0.671	0.675	0.017	0.632	0.717	6.3%
6/18	0.638	0.784	0.722	0.683	0.674	0.689	0.698	0.020	0.646	0.751	7.5%
6/19	0.673	0.841	0.759	0.683	0.694	0.724	0.729	0.026	0.663	0.795	9.1%
6/20	0.714	0.868	0.759	0.746	0.762	0.734	0.764	0.022	0.707	0.820	7.4%
6/21	0.729	0.876	0.799	0.801	0.803	0.812	0.803	0.019	0.754	0.852	6.1%
6/22	0.753	0.876	0.824	0.819	0.819	0.869	0.827	0.018	0.780	0.873	5.6%
6/23	0.753	0.885	0.837	0.840	0.844	0.889	0.841	0.020	0.790	0.893	6.1%
6/24	0.774	0.899	0.863	0.870	0.868	0.889	0.861	0.018	0.814	0.908	5.5%
6/25	0.827	0.928	0.879	0.911	0.868	0.896	0.884	0.015	0.847	0.922	4.2%
6/26	0.850	0.956	0.892	0.911	0.925	0.903	0.906	0.014	0.869	0.943	4.1%
6/27	0.919	0.975	0.892	0.980	0.949	0.914	0.938	0.014	0.901	0.975	3.9%
6/28	0.984	0.999	0.937	0.990	0.968	0.931	0.968	0.012	0.939	0.998	3.1%
6/29	1.000	0.999	0.973	1.000	0.982	0.966	0.987	0.006	0.971	1.002	1.6%
6/30	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	1.000	1.000	0.0%

[a] Relative precision